PROCEEDINGS

OF THE

ROYAL SOCIETY OF MEDICINE

EDITED BY

SIR WILLIAM HALE-WHITE, K.B.E., M.D.

AND

T. WATTS EDEN, M.D.

UNDER THE DIRECTION OF

THE EDITORIAL COMMITTEE

VOLUME THE NINETEENTH

SESSION 1925-26

PART III

SECTIONS:—

LARYNGOLOGY MEDICINE NEUROLOGY

OBSTETRICS AND GYNÆCOLOGY ODONTOLOGY OPHTHALMOLOGY

ORTHOPÆDICS OTOLOGY PATHOLOGY PSYCHIATRY

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THERAPEUTICS AND PHARMACOLOGY TROPICAL DISEASES AND PARASITOLOGY

UROLOGY WAR

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The Society does not hold itself in any way responsible for the statements made or the views put forward in the various papers.

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Section of Laryngology.

SUMMER MEETING.[1]

President—Dr. A. Logan Turner.

Large "Pharyngostomes," a Complication of Laryngectomy: How to Avoid them: The Technique of their Closure.

By A. G. Tapia, M.D.(Madrid).

The author classifies the causes of the opening of the wound into two main groups:

(I) Lack of nutrition in the skin flaps and in the edges of the opening into the pharynx. (II) Infection of the wound.

The closure of the pharyngostome requires a double wall of tissue. (*a*) The internal flap or deep layer obtained from the mucous membrane of the pharynx alone, or from the mucosa of the pharynx and base of the tongue. When there is not sufficient mucous membrane, the deep layer must be made by turning in flaps from the skin surrounding the pharyngostome.

(*b*) The external flap or cutaneous layer is used to cover over the deep layer. The flap is made from the skin of the surrounding parts and is placed in position, as a rule, by rotating the pedicle, and sometimes by sliding it over the raw surface of the internal flap.

Great importance is attached to the method of inserting the sutures.

Discussion.—Mr. Wilfred Trotter said that the time had passed when it was possible to contemplate the removal of a malignant growth in the pharynx or larynx leaving the patient to struggle with the necessary mutilation that the mere removal of the tumour inflicted. It had become necessary before undertaking any radical operation to consider in what condition the patient would be left, and, indeed, whether his life afterwards would be worth living at all. Therefore any radical operation must contain some plastic procedure designed to restore to the patient a tolerable existence.

The objective of such plastic procedures was twofold. First, there was the overwhelmingly important question of function; how was the patient to be allowed to speak after such an operation? And, in many cases, how was the patient to be allowed to swallow? He (Mr. Trotter) did not think anybody could be contented with any surgery of malignant disease of the pharynx and larynx which did not offer a patient a reasonable chance of maintaining his more or less natural powers of speech and swallowing. There was a second objective, however, in contemplating plastic procedures in these cases, and that was the extreme importance of not leaving any extensive raw surfaces in communication with the pharynx, and thus liable to infection, with its very serious dangers of cellulitis in the neck, and secondary hæmorrhage. Therefore there was a twofold object in treatment: (1) restoring the patient to a tolerable existence, and (2) greatly diminishing the danger of the operation, and —incidentally—the length of the convalescence. For instance, in such a condition as post-cricoid carcinoma—a bugbear of surgery—one could, in a reasonably favourable case, have the patient speaking and swallowing normally within six weeks of the primary operation, and that without having undergone any very great risk to life.

Taking the pharynx and larynx as a whole, one might say that at the present time there were four regions in which the need for some plastic operation had been proved and in which such operation was already regarded as practicable. He (the speaker) supposed that the simplest case was the not very common carcinoma of the posterior wall of the pharynx. It was a disease

[1] The Papers unless otherwise stated will be published *in extenso* in the *Journal of Laryngology and Otology*.

occasionally seen in women, and it was exceedingly favourable in the ordinary surgical sense, yet really very unfavourable, because one could not remove the least piece of the posterior wall of the pharynx without leaving a gap which presented all the dangers of such a raw wound. That was the simplest case for a plastic procedure; one could excise a large section of the posterior wall of the pharynx, and immediately replace it by a flap of skin, and close the subsequent fistula in about three weeks. It was a very simple case, and he (Mr. Trotter) thought the method should always be carried out in those comparatively rare cases.

The second case in which plastic reconstitution was essential was where, in pursuit of a growth in the near neighbourhood of the upper opening of the larynx, it was necessary to remove the partition between the larynx and the pharynx. Unless the surgeon did a plastic operation here, he left his patient with a funnel at the bottom which opened both the œsophagus and the trachea. In that case one must reconstruct the division between larynx and pharynx out of flaps of skin, the peculiarity of the case being that one necessarily had to use double flaps so as to leave a skin surface for the pharynx, and a skin surface for the larynx.

The third case in which plastic methods were usually necessary was in tumours of the larynx itself. It was a matter of controversy—into which he did not propose now to enter—as to whether the whole larynx should ever be removed. It was a fact that without diminishing the patient's chances of recovery, one could frequently leave half, or one-third, of one cord, or even one arytænoid, alone, removing all the rest of the larynx. If one did that, and took the trouble to line the raw surface with skin, surprisingly good results could be obtained in the way of a voice, and one could very greatly diminish the dangers of these subtotal laryngectomies by covering the raw surfaces at once.

The fourth case was that already referred to, namely, postcricoid carcinoma. One could not usually remove such a growth without making a complete section of the cervical œsophagus. If the surgeon did that, but did not reconstitute the gullet, there was always stricture, and there was great danger throughout the period of convalescence. If one prepared beforehand for the performance of a plastic operation after excising such a growth, one greatly diminished the dangers of the operation, and the patient was left in possession of the capacity for swallowing normally.

In these four primary cases no operation for malignant disease should be undertaken without the surgeon being prepared immediately to proceed with a reconstitution of the part which had been mutilated.

There were two rules which should always guide the surgeon in these plastic procedures. One was, that he must know beforehand what kind of tumour he had to deal with. That led him (Mr. Trotter) to speak of a subject which had not received the attention it demanded: the exact classification of these tumours of the pharynx. There was too great a tendency to lump them together, and not to realize that they could be separated off into exactly marked classes, so that by examination of the patient one could recognize what kind of operation would have to be performed, where the growth essentially was, and therefore what kind of plastic procedure one could prepare for before entering upon the operation. It was surprising how exact and precise one could be—if one's experience was considerable—in saying beforehand, that this was such and such a tumour, growing from such and such a place, therefore such and such a plastic procedure must be prepared for.

The second rule was that in doing plastic work in the pharynx and larynx the surgeon should secure a reasonable degree of asepsis. Sepsis more or less was inevitable in all operations on the pharynx, but it could be very greatly diminished. Even if the patient survived, sepsis involved scarring, and there was nothing more completely upsetting to the results of plastic surgery in the pharynx than a great deal of scarring. In his (Mr. Trotter's) experience there was only one means of dealing with what might be called the normal sepsis of the pharynx, and that was by seeing to the removal of the teeth. It must be recognized as a fact that good results were to be obtained with far greater certainty and safety in the edentulous than in patients who possessed teeth, however healthy.

Mr. LIONEL COLLEDGE said he wished to recount a case which illustrated Mr. Trotter's last remark on the importance of removing the teeth. The patient was a man aged 61, who had a laryngo-fissure done in Scotland in 1920 by an operator now deceased. Three years later the patient had consulted Dr. Brown Kelly, who had found a recurrence in the anterior part of the larynx. The patient had then been sent to Sir StClair Thomson, and had eventually come to himself (Mr. Colledge) to have the larynx excised. He had been advised to have all his teeth extracted, but after his dentist had removed seven the patient refused to have any

more touched. In conjunction with Sir StClair Thomson, Mr. Colledge had then excised the larynx. On the fourth day after the operation the wound had become foul and had begun to give way. On the eighth day it had completely broken down, and a severe septic bronchitis had set in. On the eighteenth day the patient was apparently moribund, but there had been a gradual improvement, and the chest condition had cleared up. An attempt at closure had next been made, but the wound had broken down again. The patient had returned three months afterwards; he had then had two more teeth removed, and he (Mr. Colledge) had operated again, but with the same result. After that, the patient had placed himself entirely in his (Mr. Colledge's) hands, and he (Mr. Colledge) had removed the man's twelve remaining teeth himself. He had then done another plastic operation, and nine days afterwards he had closed the wound. This patient owing to his obstinacy with regard to his teeth had been placed in great jeopardy, and had had a very miserable existence for six months. After the last operation he had remained well. He (Mr. Colledge) had seen him early in the present year, and he had then been on his way to the South of France.

A case illustrating the difficulty of closing the pharynx was that of a man aged 55, a solicitor, who never took exercise, drank heavily, and hence was a poor subject. He did not consult his doctor until his condition had become so serious that he suffered from stridor even when sitting down quietly. Sir StClair Thomson had advised removal of the larynx, but had seen that there was something peculiar about the case. The larynx was removed, and was found to be choked with growth, but there was another tumour in the pharynx, so that a large part of the pharynx had to be taken away. Microscopically, both were seen to be epitheliomata, but there was more than an inch of quite healthy mucous membrane separating the two tumours. A large gap was necessarily left in the pharynx. The patient had progressed very well for a month, and had then suddenly died.

Sir StClair Thomson said that the question of closing these stomata was one which was often omitted from the text-books. To read the text-books one would think that after a laryngectomy or similar operation one had only to stitch up the wound and all healed like a cut on the face from shaving! Colleagues had asked him (Sir StClair) if that was true, and he had had to reply that it frequently was not the case. Before the war, when less had been known about plastic surgery, one had to wait and pack, and watch healing going on slowly, and he (the speaker) had known the closure of a wound to occupy three months' time.

The case referred to by Mr. Colledge, in which he (the speaker) had been associated with him, was a very interesting one, because when the wound had been seen and dressed every morning pus had been noticed, and they had not known where it had come from; the area had not appeared to be purulent. One day they had packed the wound with extreme care, and when they had returned next morning pus had been found on the top of the dressing, not in the wound where it had previously been seen. It had come down from the teeth.

Sir James Dundas-Grant asked whether some of those who had operated on these cases had been tempted to allow them to heal by the open or the partially open method. He (Sir James) had been greatly impressed, when seeing Mr. Wilfred Trotter do a lateral pharyngotomy in a case which he (the speaker) had sent to him, on noticing that while he (Mr. Trotter) had stitched up the deeper parts most closely, he had only partially stitched up the superficial parts, thus leaving a space for the escape of any secretions and for packing. The result had been perfectly satisfactory. In the few laryngectomies he (Sir James) had himself done, he felt that they might as well have been done by this method, because the wounds had broken down and had been obliged to heal by the open packing method. In the cases in which he (the speaker) had done there had not been a "stoma," but the treatment had been a long one, and if he did the operation again he would consider the advisability of only partially stitching up, and would pack, as he saw Mr. Trotter do. The first case described by Mr. Colledge was absolutely convincing as to the necessity for removing the teeth.

Dr. Tapia (in reply) said that he had spoken in his paper of the care of the mouth and nose preparatory to operation. He (the speaker) never operated nowadays unless carious teeth had been extracted and other similar precautions taken. With regard to the tonsils, owing to the age of the patients in these cases, the tonsils rarely gave trouble. Naturally, if he (Dr. Tapia) found them to be infected, he would remove them.

Speech after Laryngectomy.

(1) Speech without a Larynx.

By Professor H. Burger (Amsterdam).

Professor Burger exhibited a patient, Mr. H., aged 39, upon whom he had, three years ago, performed laryngo-fissure for cancer of the vocal cord. There had been a rapid recurrence, and the patient was admitted to the University Hospital, under Professor Noordenbos. After a previous gastrostomy the larynx was removed. The wall of the pharynx having necrosed a plastic operation was done and a great skin-flap of the neck used for the formation of a new pharynx. A part of the external wound was covered by a flap taken from the thigh.

The success achieved has been complete. Now, after three years, Mr. H. may be considered cured from his malignant disease and moreover he has a new and fair speech, allowing him to perform all his business and to be a quite normal person in society.

It should be observed that the mouth of the windpipe is situated in the neck, and that there is no communication whatever between the lungs and the pharynx or the mouth. Of the three elements composing speech: the lung with the windpipe as a bellows apparatus; the larynx as the organ of intonation and the articulating apparatus, this person only possesses the latter. Yet he can speak distinctly and sonorously. The voice is not quite clear. However, it is sometimes remarkably clear.

Mr. H.'s voice is low. Also before operation he always had a low voice, and in singing, a bass. He produces all the speech sounds correctly.

Mr. H.'s speech is not at all monotonous. He speaks decidedly with modulation, and he can be heard all over a large room. He is a reporter of sporting papers, and is busy all day. He telephones with Berlin and Munich, e.g., to forward reports of billiard matches with many numerical data, and his figures are never misunderstood. Mr. H. delivers speeches at meetings and as secretary reads the minutes.

Mr. H. can sing. Dr. Kaiser has registered his singing voice. The graphs yielded the result that the vibrations were successively 120, 130, 140, 160, 180 and sometimes 190 (b, c, d, e, fis, g), which shows that the pitch is fairly controlled. Mr. H. produced separate vowels and words. It appeared that as to the vowels the pitch ranged between 60 and 210 vibrations. With words, still higher values are reached sometimes, namely 260 vibrations. A collective slide is demonstrated, illustrating the data obtained from several graphs. It shows: (1) that Mr. H.'s speech is certainly not monotonous; on the contrary rather more varied than in normal cases; (2) that the range of voice is two octaves, as is also the case with normal persons; (3) that his singing voice is slightly lower than the bass; (4) that the speaking voice is also a little lower than the average speaking voice of a man.

Mr. H. can also whisper; he can whistle; he can smoke and blow out the smoke through the nose. He can blow out a candle at a distance of 12 in.; he can blow his nose.

Eating and drinking cause him no trouble, especially drinking. He can take in a whole glassfull, almost without swallowing. After dinner, so with a full stomach, speaking is no trouble to him. It is even easier than at other times.

About once a month a bundle of hairs, rooted deep down in his throat, is grown into his mouth. Then Madame H. will cut them off as deep in the mouth as possible.

Taking all in all Mr. H. acts as a perfectly normal man. He looks healthy and cheerful. An outsider may possibly observe his somewhat harsh voice and somewhat peculiar manner of talking, but he will not suspect him of being deprived of his larynx.

When closely watching Mr. H., while he is speaking, one observes that no more than 3, 5 or at most 6 syllables are pronounced consecutively. Then he closes his mouth, and after a deglutitive movement continues speaking directly. He can also speak without previous swallowing, but then only for a shorter period. He never performs a number of these deglutitive movements, as it were to replenish an air-reservoir, before he begins to speak, as has been described in other cases.

Laryngoscopic examination reveals that the site of the pseudo-glottis is at the mouth of the œsophagus; and that in quiet respiration this mouth is always wide open.

By day Mr. H. always wears his tube, as he speaks better with one than without, and also better when he wears collar and necktie. When he is to speak without a collar it costs him some trouble; he holds his head in a certain position somewhat obliquely backward, "to get out the sound."

In speaking, a slight swelling arises in the neck above the fistula. By palpating the front of the neck the vibrations of the voice can be felt. Several authors, Gottstein for instance, have described similar swellings. Solis Cohen spoke of a balloon, filled by the patient and then used as an air-chamber. In these cases the pseudo-glottis was seated in the pharynx. In Mr. H. the mechanism is far different. Here the swelling is seated above the pseudo-glottis, and consequently this swelling does represent the air-chamber for his speech. In Mr. H.'s case this swelling is a disadvantage, for not until his abnormally wide hypopharynx is filled with air is it possible to utilize the other air for speech. This also accounts for the fact that he can speak better with a collar on, which lends support to the supple cervical wall at a place where the larynx has been removed.

By what force is the air from the reservoir pushed through the pseudo-glottis? It is evident that the deglutition movement, made by Mr. H. just before and every time during his speech, is always attended with an inspiration and that he expires while speaking.

Since the described deglutitive movements are rather weak and since Mr. H. never makes several consecutive deglutitive movements when about to speak, it cannot be the swallowing that constitutes the chief movement by which the air-chamber is replenished every time. It is no doubt the inspiration.

While speaking, Mr. H. makes, at the end of every inspiration, something like a deglutition, which presumably causes a little more air to be driven into the œsophagus.

Conversely, it is the expiratory pressure in the thorax that expels not only air from the lungs through the windpipe, but also the air from the œsophagus through the pseudo-glottis and the mouth. In reality, the speech-mechanism in Mr. H. is quite similar to that of the normal man: taking in air th[illegible] expansion of the thorax, giving off air through constriction of the thorax.

With Mr. H. it is not only the œsophagus which does duty for an air-chamber; the stomach also collaborates. Seemann, of Prague, denies the possibility of the stomach acting as an air-chamber for speech.

Some X-ray photographs of the stomach of Mr. H., made by Dr. Voorhoeve, are shown. They demonstrate the enormous dimensions of the stomach air-bubble. A picture taken directly after Mr. H. had finished speaking and before the next following inspiration, shows: (1) The stomach bubble has been considerably reduced in size; (2) both halves of the diaphragm have risen to a higher level; (3) the frontal dimension of the thorax is distinctly smaller than on the photograph, representing the maximal expiratory position.

These photographs show in an absolutely proving way that the stomach plays an important rôle in speaking. That it is easier for Mr. H. to speak after his dinner is readily accounted for by the familiar fact that the stomach bubble is always enlarged after a meal.

Secondly these photographs show conclusively that in order to force the stream

of air through the new speaking apparatus the abdomen as well as the thorax is contracted to the utmost degree.

That Mr. H., when he is speaking, uses air from the stomach, is a remarkable thing indeed. In normal circumstances the active opening of the cardia is brought about exclusively in the chain-reflexes of swallowing, vomiting and belching. Also in our case the opening of the cardia does not occur quite independently, but pertains to a (newly acquired) intricate mechanism: the œsophagus-speech.

(For a complete description of the case see *Acta Oto-laryngologica*, 1925, vol. viii, p. 90 (H. Burger and L. Kaiser, "Speech without a Larynx").)

(2) The McKenty-Western Artificial Larynx.

By Lionel Colledge, F.R.C.S.

Mr. Colledge showed two cases illustrating the use of the McKenty-Western Artificial Larynx after laryngectomy.

(3) A Simple but Effective Artificial Larynx.

By R. Graham Brown, L.R.C.P.Lond., M.R.C.S.Eng. (Brisbane, Queensland).

The difficulty in overcoming the escape of saliva around the pharyngeal opening of the artificial larynges, and the consequent discomfort to the patient are so great, that most surgeons (and patients also) have preferred to do without such aid to the production of a voice.

The apparatus which I am about to demonstrate will, I believe, appeal to you both as regards its simplicity and its efficiency.

The case for which I devised the apparatus is that of a woman now 58 years of age, a public hospital patient upon whom I performed a complete laryngectomy in August, 1920, for extensive intrinsic cancer of the larynx. She was completely healed in fourteen days and there was then no pharyngeal opening.

During November, 1923, I made an attempt at producing an artificial larynx by means of a "tube" flap, and a very good voice resulted. However, the difficulty encountered because of the saliva escaping made me discard the method, and a plug of vulcanite was used to block the pharyngeal opening. Several models of artificial larynges were tried, but with the same unsatisfactory result, namely, the escaping of saliva. The "tube" became dilated on account of the upward pressure made in order to block the opening effectively. I had a happy thought, and by using the smallest sized Heath's aural speculum, which is long and narrow in its meatal part (oval 4 mm. × 2·5 mm.) and tying it over the vertex, I found that not only was the saliva controlled around the pharyngeal opening but that none escaped through the speculum itself. The retaining tapes passed through two holes, at opposite sides, on the wide margin of the speculum.

The apparatus was completed by using a violin pitchpipe "D" or "G," which was fixed within the wide opening of the speculum, at first by means of a small piece of rubber tubing but later by soldering a small band of metal of a convenient size. These pitchpipes can be procured for a few pence each. A thin shield of pink vulcanite was then made to fit closely to the front of the neck except at its superior border, where a small space was left between it and the neck. The shield was held in position by tapes which pass around the back of the neck. The loose fit at the superior border allowed breathing to take place without hindrance, and when speech was required the head was brought forward slightly, producing, as it does, an air-tight space between the neck and the shield. Expiration then was solely by way of the pitchpipe.

The patient can use the above apparatus with comfort between meals, i.e., for at least three hours on end, after which it is removed and cleaned. The small opening of the speculum first used interfered with the strength of the voice, and I have, in the model here before you, used one which is slightly larger in its calibre. Flanges have been added laterally and the wide end is also slightly moulded to fit the opening (pharyngeal). This instrument was made for me by a dentist friend. This patient has an excellent voice and can be heard distinctly beyond an ordinary room.

The points I wish to emphasize are: (1) Simplicity and cheapness of apparatus; (2) almost total absence of escape of saliva for long periods; (3) a voice of good strength.

I claim that this apparatus makes its use worth while, whereas the instruments I have knowledge of can only be worn for so short a period at a time that their use is soon discarded by patients. I would point out that the narrower the opening at the apex of the speculum the more effective it is in controlling the escape of saliva, whereas it reduces the strength of the voice and to a degree the pitch, which is raised. I selected a Heath's type of speculum because of its wide base and long narrow body.

In the case here illustrated the pharyngeal opening lies immediately below the hyoid bone; the apex of the speculum, when in position, projects upward and slightly backwards into the pharynx, about three quarters of an inch of the "tube" being free in that cavity. My explanation of the little inconvenience arising from the saliva is that the speculum fits snugly into the pharyngeal opening (without much pulling from above) and that the small pharyngeal opening and steep, sloping sides allow the saliva to slip past the tube. The speculum is made of gold. Silver I found was affected by the saliva and was fairly rapidly eaten away. Vulcanite was likewise tried, but in order to get it sufficiently strong it had to be made thick and so of larger size, with a smaller calibre than the silver or gold specula. Rubber has a tendency to attract saliva. Moreover the strength of the voice and the pitch were considerably interfered with.

If the pitchpipe alone is fixed in the sinus (with suitable rubber tubing) there is no alteration, appreciable to the ear, in the pitch. The strength of the voice is at its maximum. A speculum of medium small size gives the best all-round results. With a very narrow outlet there is a raising in the pitch and a lowering in the strength of the voice. Speech is of course in a monotone; this can be altered to suit the patient's fancy. I have found that "G" gives the most useful voice.

It may be that I am fortunate in having such a good result and I should like to hear from any surgeon who might be persuaded to try the method, the results of his experience of the apparatus. I should be pleased likewise to provide any details, and any surgeon desiring to have them need but make his request known to me.

The case has been shown before meetings of the British Medical Association (Australian Branch) held at Brisbane.

The apparatus demonstrated has been worn for over nine months and was in use up to the time the writer left Australia.

Discussion.—Dr. TAPIA said that Professor Burger's case was an exceptional one; but he (Dr. Tapia) had himself had two or three patients who spoke quite as well. The method required a good deal of intelligence and perseverance on the patient's part, and the ordinary patient was not likely to succeed with it. He (the speaker) did not encourage it, because if patients got used to it they could not use the instrument which he himself recommended. He claimed that his own instrument was physiological, and it could be tuned by means of screws. Among his patients was a barrister, who went into court and talked for hours with this machine, and there was a remarkable absence of fatigue. There were many modifications of his (Dr. Tapia's) instrument. One man disguised it so that he was supposed to be merely smoking a pipe. He (the speaker) was now working on another model, having a tunnel in the mouth so as to avoid Stenson's duct. He was also preparing a book dealing with the subject.

Sir JAMES DUNDAS-GRANT exhibited to the meeting a patient whose larynx he had removed two years previously, and who, although she had no voice, had such wonderful articulation that she did her own shopping by word of mouth, and was readily understood.

PROFESSOR BURGER (in reply) said there were three kinds of speech, and the first was illustrated by this last patient and by Mr. Colledge's first patient, namely, speech without intonation and independent from respiration. The lady made speech with the muscles of her mouth and tongue, but she had only a very small quantity of air, and with that she could produce the speech. The second method of speech was by means of instruments. The case he was showing was not so exceptional as Dr. Tapia said it was, and the speech mechanism was essentially the same as that in the normal man. The third type was that exhibited by himself, consisting of a vicarious glottis formed anywhere in the pharynx or œsophagus.

Methods of Caring for Diseases of the Pharynx, Larynx and Mouth.

By CHARLES H. MAYO, M.D. (Rochester, Minn., U.S.A.).

Dr. MAYO gave a general talk on developments in the treatment of infections. He first drew the attention of the meeting to the chemical stimulus to cell growth that occurs in infection, and urged that we should have in mind not only the mere presence of a germ but ask ourselves "what is the chemical place and normal action of that organism in the world?" He referred to his "father's day," and thought that "observation was carried to a further point than it is to-day," instancing especially the changes that are seen in the tongue. He then suggested that the deposits of lime upon the teeth, or as stones in the kidney, were formed by the same processes as had gone on in the Cambrian period and were now taking place at the bottom of the sea. Lastly, he urged the study of the varying effects of infections upon the race at different periods of life; he pointed out that men have a "change of life" as well as women, and advised the study of the bacteriology of the genital tract—"the cervix uteri in women, the prostate and seminal vesicles in men"—as a possible alternative site of infection at this age.

Sir STCLAIR THOMSON said this was rather a matter to think over seriously than to discuss. It was a case for what the French termed "thinking furiously." Some had heard the jibe that a surgeon was a medical man who used his hands, and that a physician was a medical man who used his head. Some might have had the idea that in the great Rochester Clinic a man was put in mechanically at one end, like the pigs in Chicago, and came out alive but eviscerated at the other. But the address just delivered showed that the surgeon was a man who used his head and his imagination as much as he used his hands.

Tracheotomy in Tuberculous Laryngitis.[1]

By T. RITCHIE RODGER, M.D.

DETAILS are given of four cases in which the author resorted to tracheotomy for the relief of dyspnœa, with cure of the laryngeal conditions resulting in three of them. In all of these a fatal issue would almost certainly have ensued from obstruction to the breathing, and the author presumes that there is general agreement as to the propriety of operation in such circumstances. He then raises the question whether the operation should have a place in our scheme of treatment apart from such urgent demand for the relief of dyspnœa. He discusses the various functions of the larynx, which include, besides the production of voice, the laryngeal movements of deglutition and respiration, and also the closure of the glottis to achieve fixation of the chest in movements of the upper limbs and the abdominal muscles. He concludes that tracheotomy does not appreciably eliminate any of the laryngeal movements not

[1] For complete paper see *Journal of Laryngology and Otology*, Oct., 1925, vol. xl, No. 10, p. 639.

concerned with voice production, and that therefore absolute silence, if it can be attained, provides almost as much physiological rest to the larynx as can be achieved by tracheotomy. A fifth case, however, is added to the list, in which the patient seemed temperamentally incapable of practising silence, and in which the performance of tracheotomy seems to have arrested the downward progress.

Discussion.—Sir JAMES DUNDAS-GRANT said he thought that in these cases in which Dr. Ritchie Rodger had done tracheotomy he was well justified. But to carry out that operation in cases in which there was no stridor or obstruction would require consideration, and would depend to a great extent on the condition of the lungs. If the larynx was affected and the lungs only slightly so, it might be done. Dr. Ritchie Rodger had not described the lung condition in these patients. With regard to producing rest, in one of the late Sir Felix Semon's papers the author said that it was only in quite a small proportion of the cases that one could see the respiratory movements as described in physiological works. The natural position of the vocal cords in quiet respiration was due to the shape of the cartilages when they fell into the intermediate position. He (the speaker) had had to do tracheotomy in very few cases, but in one there was a confirmation of Dr. Ritchie Rodger's opinion of the beneficial effect arising from it. A girl had tuberculosis of the larynx, and was sent to a home for the dying. She developed stridor, and the surgeon in charge said she was too ill for tracheotomy to be attempted on her. But she insisted on being brought back to Brompton Hospital, where the speaker performed tracheotomy at once. She is still alive, and able to do without her tracheotomy tube.

With regard to securing rest, he asked whether any member had experience of the method of attempting to paralyse the recurrent laryngeal nerve by cutting or freezing it, or by injecting alcohol into its neighbourhood. When to this was added the suggestion of gastrostomy in order to neutralize the movements of deglutition, it seemed that some wished to go ahead too fast. He did not think those drastic measures would be taken while we obtained such good results from silence.

Mr. E. D. D. DAVIS said that at Mount Vernon Hospital there were many cases of advanced laryngeal tuberculosis, and during a period of two years tracheotomy for urgent dyspnœa was only done twice. Tracheotomy should be avoided for two reasons: (1) The wound became very septic, there was a mixed infection, and the patient did not improve. (2) As a result of the tracheotomy the cough was much increased and caused considerable damage to the larynx. Arrest of the cough was as important as silence.

Sir STCLAIR THOMSON said he thought tracheotomy, as a curative method, was seldom called for in cases of tuberculosis. Out of 450 cases of tuberculosis of the larynx at Midhurst Sanatorium he had had to do tracheotomy only two or three times on account of dyspnœa, i.e., in order to save the patient's life. In two or three other cases in which he would have liked it done, the patients had declined it. One was that of a doctor, who at no time in his illness had tubercle bacilli in his sputum. He declined tracheotomy and said he would try the alternative, which was to keep silence and remain in bed, when, as in most cases, respiration was restored. That patient had to have tracheotomy done at a later stage, and he died.

He asked in how many cases of Dr. Rodger's there were tubercle bacilli. People could even die of tuberculosis without the bacilli being discovered in their sputum. It was in those cases with laryngeal symptoms and in which no tubercle bacilli could be found in the sputum that tracheotomy as a therapeutic measure was most promising.

Dr. P. WATSON-WILLIAMS said that tracheotomy afforded immense relief in some cases of tuberculosis in which there was dyspnœa, and prolonged life for a time, but he (the speaker) had never seen a case in which tracheotomy saved the patient and led to a cure. The disadvantages to which Dr. Ritchie Rodger had alluded seemed to outweigh such advantages as could be attributed to that operation as a curative method. Complete rest could not be obtained without paralysing the musculature, but that would, of course, place the patient in greater difficulties still.

With regard to the position of the vocal cords when at rest, the late Sir Felix Semon pointed out that the position of rest, as distinguished from the cadaveric position, was due to the persistent tonus of abductors of the cords (posticus muscles) whereby, in the position of rest, a wider aperture of the glottis was maintained than in complete paralysis of the cords or in the cadaver.

It was often very difficult, in cases of laryngeal tuberculosis, to determine how far the lung was involved, as the physical signs of the lung disease frequently became so obscured owing to the larynx being involved. In some cases there might be a practical absence of physical signs and yet in these cases post-mortem examination would show lung involvement far beyond what had been expected.

Dr. DOUGLAS GUTHRIE said that ten days ago he had had occasion to perform tracheotomy on a lady with extensive tuberculosis of the lungs and larynx. She was well advanced in labour at the time and her child was born four hours after the operation. The progress of the labour did not seem to have been influenced by the tracheotomy though it was as yet too early to speak of the probable later effects.

In the second case mentioned by Dr. Ritchie Rodger was the iodide which was administered the cause of the œdema of the larynx?

Dr. RITCHIE RODGER (in reply) said that in the first case there had been no appreciable lung disease, and this was largely true of the second case although the sputum had on one occasion contained tubercle bacilli. In the third case there had never been any obvious lung lesion; in fact, the tuberculosis officer considered the glandular condition to be due to lymphadenoma. Removal and examination of the glands, however, had settled the point to the speaker's satisfaction, and the complete recovery of that patient in four months with no other than sanatorium treatment seemed to confirm the tuberculosis view. In the fourth case the lung condition had been the dominant feature, and in the fifth case there had been a definite lung lesion, which, however, had improved before he (the speaker) had seen the patient. Tubercle bacilli were found in the sputum in three out of the five cases, and in the two cases in which the result of the search was negative the patients made the most dramatic recovery in the matter of time.

With regard to the effect of the iodide, there was an impression that it was wrong to use iodide in inflammatory conditions of the larynx. The subsequent history of the second case showed that there had been an abscess developing in connexion with the perichondritis; this had burst three weeks after the tracheotomy, so that the iodide could be exonerated from blame.

Furuncle of the Right Nasal Vestibule; Septic Thrombosis of the Cavernous Sinus; Lepto-Meningitis; Death; Autopsy. (With Microscopic Examination of the Orbits, Cavernous Blood Sinuses, Meninges, Ethmoidal and Sphenoidal Air Sinuses.)

By A. LOGAN TURNER, M.D., F.R.C.S.E., and
F. ESMOND REYNOLDS, M.B.

A MALE, aged 33, developed a furuncle on the inner aspect of the right ala nasi. After rupture of the boil, symptoms and signs of cavernous sinus thrombosis and lepto-meningitis developed. The duration of the illness was six to seven days.

The nasal cavities and accessory sinuses were normal. The furuncle was the primary source of the infection: the microscopic examination revealed septic thrombosis of the cavernous and circular blood sinuses, with retrograde thrombosis of the ophthalmic veins, the spheno-parietal sinus, the meningeal veins and the veins of the diploë in the walls of the sphenoidal air sinuses.

Sir JAMES DUNDAS-GRANT said that the authors had proved their case up to the hilt. Why should the furuncle have had such a terrible result in this case? Was there some distribution of veins which was peculiarly favourable to the unusually severe extension of the suppuration? Or were the streptococci specially virulent in this case? Perhaps there was also some specially low resistance on the part of the patient. At a recent meeting of the Section of Otology,[1] Mr. Arthur Cheatle showed that the mastoid emissary vein was sometimes of very large size, and Mr. Cheatle had told him (the speaker) of a case in which a boil on the neck had led to thrombosis of that vein, cavernous sinus thrombosis, and death.

[1] *Proceedings*, 1925, xviii (Sect. Otol.), p. 29.

Intranasal Dacryocystostomy.

By J. S. Fraser, M.B., F.R.C.S.Ed.

Dr. J. V. Paterson, Ophthalmic Surgeon to the Royal Infirmary, Edinburgh, states that the treatment of disease of the lacrymal passages has always presented difficulties to the surgeon. The old treatment by probing is quite ineffective. The wearing of styles has never been widely adopted. Complete excision of the tear-sac is not an ideal operation, its aim being to remove the diseased sac and not to establish drainage. After excision, watering of the eye is nearly always a lifelong source of annoyance. In Dr. Paterson's experience the intranasal operation has given results very much better than excision.

Since 1919 forty-two patients (thirty-one female, and eleven male) have been operated upon by the writer; in five patients both tear-sacs were operated upon. Most of these patients had been previously treated by dilatation of the punctum and canaliculus, washing out the tear-sac and the passage of probes. In at least five cases the patient had an abscess around the tear-sac at the time of operation. Several of the patients remarked that the tear-sac trouble became acute from time to time, with comparatively quiet intervals.

Technique.—Local and general anæsthesia. (Submucous resection of the nasal septum, when necessary, is always carried out at the time of the tear-sac operation.) A D-shaped incision is made just in front of the anterior end of the middle turbinal, the curved portion of the incision anteriorly. The piece of mucous membrane is entirely removed with forceps, exposing the inner surface of the frontal process over an area about half the size of the middle finger nail. With the gouge and hammer the bone in the exposed area is removed, uncovering the lacrymal sac. The punctum is now dilated and the lacrymal probe passed into the sac, so that the inner wall of the sac is made to bulge inwards. The sac is next incised with a small, sharp-pointed knife, and a pair of small double-cutting forceps is introduced, so that the female blade lies inside the sac while the male blade lies against the medial wall of the sac. On closing the forceps a piece of the inner wall is punched out and this is repeated till a sufficiently large opening has been made. The opening of the sac is almost invariably accompanied by a free escape of pus into the nose.

Difficulties.—In fifteen cases the bone of the frontal process of the superior maxilla was very thick, while in six cases there was considerable bleeding. In the majority of cases the operation only occupied from ten to fifteen minutes.

No *after-treatment* is necessary.

Results.—In an earlier series of fifty cases (1915-1918), already published ("Intranasal Dacryocystostomy," by J. V. Paterson and J. S. Fraser, *Brit. Journ. of Ophthal.*, May, 1919), complete cures were obtained in 78 per cent.; considerably improved, 11 per cent. In the present series of forty-two cases, complete cures were obtained in 65·5 per cent., three after a second operation. The writer's experience of cases of epiphora without dilatation of sac and empyema is that they do not give a satisfactory result after West's operation. Several of the unsuccessful cases were of this kind.

Recurrence of the dacryocystitis is found in about 25 per cent. of cases. As a rule the recurrence occurs within two months of operation and is due to failure to remove a sufficiently large portion of the inner wall of the tear-sac. Such recurrences may be dealt with at a second operation.

Discussion.—Mr. Lawson Whale said that five years ago he had shown about twenty cases at the annual meeting of the Section, in all of which there had been West's operation.[1]

[1] *Proceedings*, 1919-20, xiii (Sect. Laryng.), p. 234.

With regard to technique: if a septum required to be resected this should be done separately and beforehand, never at the same time. If there was any difficulty in dislocating the bone into the nose after using the gouge, he (the speaker) did not think this dislocation should be effected by pressing with the finger on the inner canthus; it was better to use a large-sized probe. When using small gouges and chisels, one was working at an acute angle and at a disadvantage, for it was difficult to prevent the instruments from slipping. He had therefore devised a gouge which he called the "mashie," as it was like a golf mashie, but turned the other way. It enabled one to take a good grip. He (the speaker) passed round for inspection a sac which he had removed entire through the nose. Dr. Fraser had not indicated his criteria of cure or improvement. His own arbitrary criteria were as follows: if the eye never watered, even in a strong wind, the operation had been a complete success; if it watered only in a strong wind, that indicated a modified success; if it watered even indoors, the operation had been a failure.

Mr. A. J. M. WRIGHT said that he felt that it was submitting the patient to an unnecessary repetition of operation to do the septum resection separately.

Mr. W. J. HARRISON said that two points in technique were of considerable importance. In removing the bone care should be taken to do so in thin flakes. If it was removed in thick pieces there was considerable risk of splitting and splintering the surrounding bone; this increased the trauma and amount of granulation tissue formed and the tendency for the opening to close was thus also increased. In making the opening care should be taken to make it large, not only from above downwards but from before backwards. If this was not done it would probably close and the result of the operation be disappointing.

He thought that it was safe to operate in the case of a suppurating sac with phlegm or when the acute symptoms were subsiding. He had done so in several cases with satisfactory results.

Mr. E. D. D. DAVIS said that a number of these cases had been sent to his clinic from the Royal Westminster Ophthalmic Hospital, and the results had not been very satisfactory. Cases of suppuration and dilatation of the sac were more suitable for intranasal dacryocystostomy than were the chronic cases of lacrymal obstruction in which all other methods of treatment had been tried. These chronic cases were sent on to the nasal surgeon as a last resort. The fistula made in the nose always tended to close and the operation had to be repeated.

Dr. FRASER (in reply) said that he had used local anæsthesia in the first seventy cases, but many of the patients had felt considerable pain when the bone was being removed, especially if the bone was thick. For this reason he now operated with the aid of general anæsthesia. He had seen no evidence of infection of the ethmoid in the cases on which he had operated; but it was seldom that one opened the ethmoid cells when exposing the tear-sacs. He agreed with Mr. Whale's criteria as to cure. The cases he regarded as "cures" were those in which there was no trouble from lacrymation, either in the wind or out of it. Those he regarded as modified successes were the cases in which a strong wind still caused some trouble with lacrymation.

He agreed with Mr. Harrison about removing small pieces of bone; if large pieces were loosened, there was sometimes difficulty in removing them. In one case he (Dr. Fraser) had operated soon after an acute attack of "peri-sac" abscess, and in that case trouble had been caused by excessive bleeding, which gravely interfered with the operation. He had not had any experience of chronic cases not doing well. The case with which he liked to deal was one in which there was a large sac full of pus, not one in which there was watering of the eyes without an empyema of the sac. He had had no experience of the combined external and internal operation.

The Nasal Sinuses as a Route of Infection in Encephalitis Lethargica.

By A. LOWNDES YATES, M.D.[1]

THE author gave an account of the condition of the sinuses in twenty-three cases of encephalitis lethargica in which the diagnosis of this disease had been established beyond doubt.

From the point of view of history these cases could be divided into three main groups, namely, those following an acute rhinitis similar to an influenzal attack, those following an acute rhinitis complicating a chronic rhinitis, and those in which a chronic rhinitis and sinusitis were present.

Nasal infection of a high degree was found both clinically and by bacteriological examination in all these cases. The *Staphylococcus aureus* was the commonest organism in cases following an acute rhinitis and the pneumococcus or bacillus of Friedländer in cases following a chronic rhinitis. The rhinitis affected chiefly the mucous membrane in or around the openings of the posterior group of sinuses, the sphenoidal sinus being that most commonly affected. It was found that in these areas the characteristic of the inflammation was the paralysis of cilia, and of mucous secretion, together with a heightened absorption of substances in watery solution of the mucous membrane. By placing within the sinus a quantity of 4 per cent. indigo carmine solution this absorption could be demonstrated by the appearance of the dye in the urine in about twenty minutes. The fact of this heightened absorptive power led the author to believe that the air-borne and filter-passing virus of encephalitis lethargica must fall on soil previously prepared by inflammation so as to render the mucous membrane permeable to the filter-passing virus.

The author also describes a certain experiment with mucus *in vitro*. If viscid mucus was sterilized and mixed with living staphylococci it rapidly became liquid, and permitted the passage of water-soluble dyes to a progressively greater extent as autolysis of the mucus proceeded, while in the absence of micro-organisms mucus prevented the passage of the dye through its substance. It appeared, therefore, that in order to become infected by the virus of encephalitis lethargica an infective environment of sufficient intensity to permit the micro-organisms partially to digest the mucus was necessary, and that when this occurred the toxins, being now able to pass through the digested mucus, paralysed the ciliated epithelium, thus anchoring the mucus and permitting its complete autolysis, the final stage being reached when the secretion of mucus was also paralysed by the toxins, the protective mechanism against the filter-passing virus being thus entirely removed.

Dr. P. WATSON-WILLIAMS congratulated the author on this pioneer work in connexion with encephalitis lethargica, but he thought that Dr. Yates would himself admit it was necessary to make further observations before the ground was secure, and one must hope that he would have opportunities for such investigations. Members would recall the work of Dr. Peters in connexion with the finding of the meningococcus in the sphenoidal and other sinuses, results which seemed very definite but were not always corroborated by the investigations of others.

[1] For complete paper see *Journal of Laryngology and Otology*, Oct., 1925, vol. xl, No. 10, p. 646.

A difficulty in connexion with cases of encephalitis lay in the correctness of the diagnosis. At the last meeting he had himself brought forward two examples of sphenoidal sinus infection with ocular defects. One was a case in which there was a definite enlargement of the blind spot, with clear infection of one particular sinus, and yet this case had been set down by a previous attendant as a "missed" one of encephalitis lethargica. He (Dr. Watson-Williams) was convinced, however, that it was an instance of ocular manifestations due to simple sinus infection and that the diagnosis of encephalitis could not be sustained. He would like to hear of more definite criteria on which the diagnosis of encephalitis in the cases investigated by Dr. Yates had been arrived at.

Section of Laryngology.

President—Dr. W. H. KELSON.

PRESIDENT'S ADDRESS.

By W. H. KELSON, M.D.

"BREVITY is the soul of wit" and "example better than precept," so I will not detain you long but wish to thank you heartily for entrusting me with the Chair.

It is indeed an honour to be elected President of a splendid vigorous Section like this, the largest but one of the special Sections.

On looking round me I see not only men of world-wide fame in Laryngology and Rhinology, but also those who have distinguished themselves in war, and as orators, philosophers, scientists and humorists. Then again, one should never forget the pioneers, those able men who have gone before and who did much spade-work in building up the Section and making it what it is at present.

Nevertheless, though justly proud of all this, we must not degenerate into a self-admiration society, and I would ask, without prejudice, "Is there no fly in the apothecaries' ointment?" So come, let us glance for a moment at the other side of the picture, if such there be.

During my membership, extending over a period of more than twenty years, it has been suggested to me a good many times that an affection known as logorrhœa exists in our midst.

Now this disease has certain malignant characteristics. It is difficult to eradicate, tends to recur on removal and is damaging to vitality, interfering with the access of nourishment in the form of new blood. Those afflicted with the complaint are often quite unconscious of its presence, carried away with enthusiasm, their vocal apparatus appears almost to have solved the problem of perpetual motion, for they go on and on, apparently oblivious of the fact that time is limited and that others may be waiting to express their views.

In bad cases a cure or even relief is very difficult to obtain, and one has seen elsewhere powerful auditory stimuli and radiation treatment, in the form of red rays, signally fail.

However, I believe that in America in the old days the vision of a six-shooter lying on the Presidential table was found to be effectual.

Now, in our Section we have papers and set discussions, but our sheet anchor is, and always has been, our clinical work, so should an epidemic of logorrhœa break out it would be most disastrous. Just imagine: time nearly exhausted, programme not half through, seats half empty—vacated oft-times from sheer boredom!—exhibitors much discouraged because their cases, brought up, perhaps after considerable trouble, have been hardly touched on owing to want of time; and think that all this might have been obviated by condensation, concentration and strict relevancy earlier in the meeting.

Now let us turn for a moment to something else.

No one, I think, will deny the great importance of tracing and recording the subsequent history of some cases. During my membership two, if not more, distinguished Members of the Section, impressed with this idea, have made special arrangements for it to be done.

Unfortunately, however, the carrying out of this project is often rather difficult, so after a transient success the schemes have cooled off and almost fizzled out. Now this is a great pity, but I believe that if exhibitors will only cordially co-operate with the secretaries or other appointed officials—and this is essential to success—a method can be devised whereby selected cases can be followed up regularly and systematically and essential points in their after-histories noted.

Passing on, I wish to say a few words about the *Journal of Laryngology and Otology*. In the first place, let me emphasize the fact that it is the only British journal in the specialty, and surely we should encourage home industries before supporting productions coming to us from across the water. Besides, its interests are bound up with those of the Section, of which, apart from the *Proceedings*, it is the organ.

In the able hands of the editors in the North the journal has made wonderful progress both in quality and volume.

In conclusion, I may say that I quite realize that in these remarks I have rather gone off the lines of the usual Presidential address, but for this I make no apology, because I am sure that it is the President's duty to do his utmost in every way to promote the efficiency and interests of the whole Section

"Without fear or favour, affection or ill-will."

Case of Chronic Pharyngeal and Œsophageal Stenosis.

By William Ibbotson, F.R.C.S.Ed.

Patient, a female, aged 28. The condition has apparently existed since early childhood. The naso-pharynx is almost completely shut off from the lower region of the pharynx by bands of scar-tissue. There is extensive scarring of the posterior pharyngeal wall. In the larynx (as viewed by indirect laryngoscopy) the glottic opening is free, and the cords move in a healthy manner. The upper entrance into the laryngeal cavity is narrowed by a ring of scar-tissue, so that the pyriform fossæ are not seen, whilst the cricoidal and lower pharyngeal regions are completely hidden. The epiglottis appears to have been very largely destroyed and replaced by scar-tissue. The obstruction seems to be only to deglutition, not to respiration.

Various forms of treatment have been carried out, including œsophageal dilatation and tracheotomy (wound now closed), but owing to the extensive areas of cicatricial contraction, the patient is unable to swallow solid food. The Wassermann reaction is negative.

Discussion.—Sir James Dundas-Grant thought it might be scleroma.

Mr. W. Stuart-Low advised a trial of violet-rays.

Sir William Milligan said he considered the condition was either a post-diphtheritic cicatricial contraction, or a post-scarlatinal one, even though the history to confirm this was lacking. Where so much œsophageal obstruction existed there was a definite call for gastrostomy, to ensure adequate nourishment. Subsequently an attempt could be made, by means of bougies, to overcome the contraction. He did not think operation on the scar-tissue was of any real value.

Mr. G. W. Dawson said he had exhibited two young people at the Section[1] with a similar condition, and as far as he could ascertain, it came on at puberty, and was due to syphilis, the Wassermann reaction being strongly positive. In those cases the nose was completely cut off from the pharynx. With the aid of the dentist, who made a plate with a hollow prong, which was passed up through the scar-tissue into the nose, relief was afforded. Those patients complained of an accumulation of mucus so that the nose could not be cleared.

Mr. H. Tilley referred to two cases he had shown many years ago in which the patients were operated upon. In one, he could pass only a probe through the aperture and into the naso-

[1] See *Proceedings*, 1917, x (Sect. Laryng.) p. 100.

pharynx. Adhesions were divided thoroughly on each side in order to free the palate. At the completion of the operation it was possible to pass two fingers into the naso-pharynx. The insertion of plugs, either hard or soft, had been found to be useless. The question arose as to whether there was a method of holding the palate forward while the epithelium crept in where now the palate was joined to the postero-lateral walls of the pharynx. After the adhesions had been divided, two silver wires were passed on each side of the median line through the palate, just beyond the border of the hard palate, then over the back of the soft palate, and brought forward again just above and through the free margin of the palate. They were fixed anteriorly between and over the incisor teeth and were retained until they cut out through the soft palate (seven to ten days).[1] The patients retained a permanent opening which would admit a finger twelve months afterwards. The point was to provide some means of epithelialization of the raw surfaces, so that the parts should not cicatrize again after having been divided. If a permanent space the width of an ordinary lead pencil could be secured, mucus could be cleared from the nasal cavities, and the pain in the ear would cease. A month's trial of violet-rays might be made, but he (the speaker) favoured the operation which he had described.

Dr. BROWN KELLY said he considered the cicatricial contraction due to lupus. In his experience of such cases it was very difficult to keep the soft palate from re-uniting with the posterior pharyngeal wall. His own best results had been obtained with a hook which passed up behind the palate and was attached to a dental plate.

Extraction of Two Farthings from the Œsophagus.

By M. VLASTO, F.R.C.S.

PATIENT, a girl (aged 3½) was left to play on the floor with various articles which included two farthings. When the mother returned, it was noticed that the two farthings were missing. The child appeared as usual and made no complaint. Owing to the absence of a witness, no history was obtained of coughing, choking, &c.

From that time, the child began to show a disinclination to take her food and occasionally vomited after a meal. Because she appeared otherwise quite well, a medical man who was consulted three days after the event, suggested that the child was "shamming."

Six days after the event the child was taken to Queen Alexandra Hospital, Millbank, when as the X-ray photograph showed, the presence of "a coin" in the œsophagus at the suprasternal level was discovered.

Two farthings were removed easily with a single grasp of Paterson's forceps.

The case is shown on account of the peculiar history, the complete overlapping of the coins and the rarity of such an occurrence.

Discussion.—Mr. W. H. JEWELL said that six years ago he had a similar case, that of a child 3 years old, who had two halfpennies in the œsophagus at about the sternal notch; there was no sickness, and the child could swallow well. He passed an œsophagoscope over the coins without seeing or dislodging them, but on withdrawing it and pressing back a fold of mucous membrane he saw the two coins distinctly, and removed both together at one time with Brünings's forceps. A skiagram from the antero-posterior position showed only one coin, and the radiologist said that from the lateral aspect he saw two edges which merged into one, and therefore he believed that only one coin was present and that the aberration was due to obliquity.

Dr. LOGAN TURNER mentioned two similar cases. In one, after dinner, the patient's wife threw a handful of pennies into the air. At that moment her husband who was laughing, accidentally swallowed one. A skiagram suggested the presence of one coin, but on passing the œsophagoscope Dr. J. S. Fraser removed three pennies; the patient then stated that two other coins had been missed.

[1] See *Proc. Laryng. Soc. Lond.*, 1903, x, p 81.

The other case, under the care of Dr. G. E. Martin, was that of a child who swallowed two halfpennies simultaneously. The skiagram showed a somewhat oval shadow suggesting partial overlapping of the two coins.

Mr. VLASTO (in reply) said that the period following the swallowing of the coins was not quite free from symptoms, since the child had shown disinclination to take her food and there had been occasional attacks of vomiting.

A Case of Œsophageal Carcinoma treated by Intubation with Souttar's Tube.

By M. VLASTO, F.R.C.S.

PATIENT, a man aged 53, first complained of dysphagia in April, 1925. On admission to hospital in September he was swallowing liquids with difficulty. A 6-mm. Souttar tube was introduced, and the patient is now able to swallow minced meat with ease.

The patient is accompanied by an X-ray photograph showing the tube in position. The case is shown with a view to eliciting information from Members of the Section as to their experience of this form of treatment.

Discussion.—Mr. T. B. LAYTON quoted a case in which this method of treatment had been of great benefit to the patient.

Mr. WALTER HOWARTH said that he could claim a fairly long acquaintance with this method since it dated from the day that Mr. Souttar's article appeared. He happened to have a suitable case, so he borrowed a tube from Mr. Souttar and inserted it that afternoon. That was in May, 1924. The after-history of this case was remarkable, as the patient, an old lady who lived in Somerset, wore the tube continuously until she died in September, 1925, a period of fourteen months, and it functioned all the time. Her local practitioner X-rayed her from time to time to see that the tube was still in position, and at her death a few weeks ago he made a post-mortem examination. This showed that the carcinoma then involved the whole circumference of the œsophagus, encircled the aorta and had perforated the bronchus. The duration of this case was of course unusual and he would say that six or seven months was the average time. He had found that the cases most suitable for intubation were not the fungating growths but the intramural or extra-œsophageal growths which narrowed the lumen.

Previously he had used gum elastic or vulcanite tubes, but they required cleaning and replacing once a month, whereas these metal tubes need never be changed. If blocked by food, sipping hydrogen peroxide in water was often sufficient to clear the tube. Mr. Souttar often dilated these strictures very forcibly before inserting the tube, but the speaker was rather afraid of doing this and so was often content with a smaller tube. It was extraordinary what a great deal could be swallowed through a tube with a very small lumen.

Dr. W. S. SYME added his testimony to the efficacy of the Souttar tube, and exhibited three skiagrams showing the type of stricture with the tube in position, indicating that a narrow stricture would bear a fair-sized tube. In three days the man was able to travel to Devonshire, and said he was comfortable and was swallowing minced meat.

Mr. VLASTO (in reply) said that, from the remarks made by various Members of the Section, one might be led to think that the passage of a Souttar's tube was always a comparatively easy procedure and that their efforts had been attended with uniform success; this had not been his (the speaker's) experience. The statement had been made that the tube could be passed through any ordinary œsophageal tube. He (Mr. Vlasto) wished to emphasize the fact that the bore of the œsophageal tube so used must be at least 16 mm., and that such a tube did not, as a rule, form part of the usual hospital theatre equipment. His (the speaker's) experience of this treatment had been confined to three cases. In the first case he had been unable to dilate the œsophagus sufficiently to admit the passage of a tube. In the second case he had been obliged to remove the tube three days after inserting it, because the patient had been totally unable to swallow; in that case the Souttar tube had been blocked by growth and blood-clot. The third case was the successful one which he had now exhibited.

A Case of Chronic Lymphatic Leukæmia associated with Enormous Enlargement of the Faucial Tonsils.

By M. VLASTO, F.R.C.S.

THE patient, a woman aged 50, attended the West London Hospital complaining of a lump in the neck. On examination the tonsils were found to be very enlarged. The following is typical of the many blood-counts that were carried out:—

Total red cells	3,813,000	Total white cells	38,200
Hæmoglobin	62 per cent.	Small lymphocytes	88 per cent.
Colour index	0·8	Polymorphonuclear leucocytes	7 ,,
		Mononuclears	2 ,,
		Eosinophils	1 ,,

The Wassermann is negative. There is a slight enlargement of the spleen, and glands are enlarged in the axillæ and groins.

As the size of the tonsils is beginning to cause dysphagia, expressions of opinion are invited as to the best form of treatment.

Discussion.—Dr. JOBSON HORNE said he was opposed to the surgical removal of tonsils in lymphatic leukæmia. In this particular case he gathered that the tonsils, together with the glands in the axillæ and groins, had materially subsided under general treatment; further, that the tonsils were not causing inconvenience. He therefore saw no reason for local interference.

Dr. H. SMURTHWAITE said that two years ago he had had a patient with tonsils larger than in this case, and with a mass of enlarged glands on each side of the neck, suggesting a malignant condition. He (the speaker) had dissected out one tonsil and examined it, and had found that it consisted mainly of fibrous tissue, containing epitheliomatous cells. There was severe bleeding at the time of operation, and later the patient was put on to a course of arsenic. She now looked ten years younger; and the other tonsil and the glandular masses had greatly diminished in size. The patient had now lost all her anæmia after being put on to increasing doses of arsenic. He (Dr. Smurthwaite) did not think that case could have been malignant.

Sir JAMES DUNDAS-GRANT suggested the possibility of benefit following the insertion of radium needles, or exposure to X-rays.

Mr. W. STUART-LOW said that good results had occurred in a similar case following repeated puncture—once a month—with diathermy needles. Large doses of collosol calcium were also used. The very large tonsils gradually became smaller and firmer; after six months' treatment they were enucleated in the usual manner and there was no excessive hæmorrhage.

Sir WILLIAM MILLIGAN said he did not think any operative interference was required. The tonsils were not sufficiently large to require diathermy or dissection. He agreed with Dr. Smurthwaite that if arsenic was given intravenously or by the mouth in these cases, there was a marked improvement. Operation for such a condition was always accompanied by considerable danger and the underlying disease was a blood disease.

Mr. H. TILLEY said that for many years it had been recognized that arsenic caused a diminution in the growth, sometimes amounting to complete absorption. Then there was a recurrence, and if the administration of arsenic was then pushed the patient suffered from arsenical neuritis.

Sir STCLAIR THOMSON said it was desirable to be on guard about tonsils enlarging in middle-aged people. He was once called in to see a lady who insisted on having her tonsils removed, partly because she was feeling tired, and partly because she had several tea-parties to attend, and at that time the removal of tonsils was very much the mode. Finding the lingual tonsils also much enlarged, he had her blood examined; there was lymphatic leukæmia found to be present, therefore he declined to operate. He was thereupon dismissed from the case, and she was operated upon by a colleague, who knew what was the matter

with her, he also having had a blood-count done by another pathologist. He (Sir StClair) consulted several pathological friends, and they said that removal of the tonsils could not make any difference. The lady died two years later. He suggested that a systematic examination of lingual tonsils in these middle-aged people would sometimes put the examiner on the look-out for lymphatic leukæmia.

Dr. IRWIN MOORE advocated the use of London paste in this case.

Mr. VLASTO (in reply) said that, although the tonsils were still very large, they were very much smaller than when the patient first presented herself for examination. This diminution in size had no doubt been achieved by the local X-ray therapy to which the tonsillar region had been subjected.

Section of Laryngology.

President—Dr. W. H. Kelson.

Further Report of Cases Previously Shown.

Congenital Stenosis of the Larynx.[1]

By Philip Franklin, F.R.C.S.

The child died of pneumonia a few weeks after the meeting in June, 1924, a tracheotomy having been done for urgent dyspnœa. An examination of the specimen[2] confirms the fusion, to which the exhibitor originally drew attention, of dense fibrous tissue in the form of a wedge extending into the trachea well below the cords. It

would therefore have been almost impossible to excise this tissue by any intra-laryngeal route. Should an operation be indicated in this type of case I suggest that a laryngo-fissure would be the only way to deal with it satisfactorily.

[1] *Proceedings*, 1925, xviii (Sect. Laryng.), p. 12.

[2] Now in the Royal College of Surgeons Museum, London.

Discussion.—Sir WILLIAM MILLIGAN asked whether there was any history of a foreign body having been inhaled or swallowed and become impacted at the back of the larynx, so acting as a local irritant. The localized mass seemed to consist of inflammatory tissue.

Mr. E. D. D. DAVIS said he had seen laryngo-fissure done in children for the removal of papillomata, and as a result they all had stenosis; there was a definite risk of this happening in children after that operation. Not long ago he saw a well-developed man, aged 21, who had a very large web of the larynx, and the orifice of his larynx would only admit an ordinary pencil. He was quite normal, except that he complained of loss of voice. He refused to have any operation done.

Sir STCLAIR THOMSON said that he had himself seen but few of these cases, and he would like those who had not seen such cases to listen to what had been handed down by tradition, and what Mr. Franklin's case confirmed, viz., that these webs were so very tough that it was almost impossible to remove them by an intra-laryngeal operation. If they were traumatized in any way, that only increased the laryngeal stenosis. Recently he had seen a girl, aged 21, who was disappointed because he advised her to put up with a similar condition. She was a school teacher; she had some voice, but she was unable to teach singing.

It was pointed out by Semon, many years ago, before cordectomy had been suggested, that laryngo-fissure tended to some extent to cause cicatricial narrowing. In some cases one was glad it did so, as it formed a new vocal cord. Cases were on record in which children had had laryngo-fissure done 6, 12—in one case 18—times for papillomata, but the operations did not cure, for they left such a stenosed larynx that a tube had to be worn for life. In this present case, as Mr. Franklin showed, the membrane extended down towards the subglottic region.

Mr. HAROLD BARWELL suggested that in laryngeal stenosis in children—not necessarily of the congenital form—members should consider the advisability of prolonged intubation. At a meeting of the British Medical Association in 1909, Bryson Delavan, of New York, described O'Dwyer and Rogers' method of intubating the larynx by anchoring the tube through the tracheotomy fistula in the neck.[1] He (the speaker) had tried it in the case of two children of $1\frac{1}{2}$ and 3 years of age—one had been drinking out of a kettle and the other had had a hurried tracheotomy done too high—and both did very well.[2] The tubes were kept in for nine and ten weeks respectively, and the stenosis had not returned when the children were last seen, six months and two and a half years afterwards.

Mr. FRANKLIN (in reply) said that there was no history of a foreign body. He watched the child for eighteen months and during that period there was never a sufficient degree of distress to indicate either the necessity to perform a tracheotomy or to use intubation tubes. In this case the small opening between the cords would not permit the introduction of the smallest intubation tube. When the case was originally discussed, the question arose as to what to do for the occasional stridor. He agreed with Sir StClair Thomson that it was better to avoid operative procedures until such time as more urgent manifestations rendered them necessary. He pointed out that this specimen showed that the cause of obstruction in these cases was not the thin, bluish membrane described in the text-books.

Case of Sarcoma of the Nasal Septum.[3]

By PHILIP FRANKLIN, F.R.C.S.

THE first pathological examination showed a chronic inflammatory condition; but a subsequent report was to the effect that it was a round-celled sarcoma. The patient's nose was now quite healed, and though secondary deposits might possibly appear later, there was at present no indication of sarcomatous tissue in the nose. All the tissue possible was removed at the operation, and subsequently Dr. Finzi treated it with radium and X-rays.

[1] *Brit. Med. Journ.*, 1909, ii, p. 1144.
[2] *Lancet*, February 26, 1916, p. 462.
[3] *Proceedings*, 1925, xviii (Sect. Laryng.), p. 24.

Discussion.—Dr. JOBSON HORNE said the subsequent history of the case seemed to confirm a dictum he had often expressed, that malignant disease was diagnosed more often than it existed.

Sir JAMES DUNDAS-GRANT asked whether Dr. Jobson Horne referred to the difficulty of microscopical diagnosis. He (the speaker) thought it was often difficult to distinguish small round-celled sarcoma from an inflammatory growth. He had had a case with the late Dr. Clayton Fox, in which that gentleman removed a portion of a growth on the side of the septum, and the microscope showed it to be a melanotic sarcoma. The growth was then completely eradicated but the diagnosis was confirmed by a subsequent recurrence of the disease, from which the patient died.

Dr. JOBSON HORNE (replying to Sir James Dundas-Grant) said melanotic sarcoma was a very definite and most malignant condition; he (Dr. Jobson Horne) said he was referring to the large number of cases in which a chronic inflammatory condition was diagnosed and treated as sarcoma.

NEW CASES AND SPECIMENS.

A Case of Perforation of the Palate.

By H. BELL TAWSE, F.R.C.S.

MRS. J., aged 43. Intranasal trouble for many years. Operation on both ethmoids in 1911 on account of nasal obstruction and crusting. Has douched her nose morning and night ever since. Plate of teeth fitted June, 1925, never comfortable.

September 7, 1925, red spot appeared at the junction of the hard and soft palate, rather to the right side; soon after, pin-hole perforation appeared.

September 19.—Given pot. iod. gr. x, t.d.s.

September 26.—First seen by exhibitor, perforation size of split pea. Diagnosis: tertiary syphilis. Wassermann test negative. Pot. iod. increased to gr. xxx with liq. hydrarg. perchlor. ♏ xxx t.d.s. Small pustule appeared to the right of perforation, it burst, and a second perforation seemed probable.

October 6.—Perforation getting larger. Wassermann test again negative. Pot. iod. and hydrarg. stopped.

October 8.—Injection of novarsenobillon given; caused so much upset that no more was given. Appearance of upper surface of palate suggested breaking-down gumma.

October 22.—Wassermann test negative. Pot. iod. gr. xxx, liq. hydrarg. perchlor. ♏ xxx t.d.s. begun again.

November 1.—Perforation larger, pot. iod. and liq. hydrarg. perchlor. stopped. Emuls. ol. morrhuæ given.

November 21.—Almost daily lavage of nasal sinuses for past three weeks. Inunction of oleate of mercury begun and continued daily.

PATHOLOGICAL AND BACTERIOLOGICAL REPORTS.

Examination of material showed considerable number of polymorphonuclear leucocytes. No tubercle bacilli found. Section from edge of perforation showed ulceration and thickening of epithelium with necrosis of submucous tissue infiltrated with polymorphonuclear leucocytes. No sign of tuberculous disease, or gumma formation, or malignant disease. The pathologist suggests that it is a simple inflammatory condition.

Examination under dark-ground illumination shows numerous organisms, but only an occasional spirochæte such as would be found in a normal mouth.

Films.—Stained films showed numerous organisms of various kinds, amongst which pneumococci appear to predominate. An occasional spirochæte seen.

Discussion.—Mr. H. TILLEY said the case reminded him of one which he had shown before the Section in pre-war days,[1] and he had asked Dr. Lieven, of Aix-la-Chapelle, a

[1] ADDISON (O. L.), and HETT (G. SECCOMBE), "Chronic Glanders in Man with Reference to an Unusual Type affecting the Upper Respiratory Tract" (with bibliography), *Lancet*, 1909, ii, pp. 1201-4. *See also* Tilley, "Diseases of the Nose and Throat," 4th ed., 1919, p. 499.

recognized authority on syphilis, who was in London at the time, to see the patient. There was extensive destruction and crusting in the nose, as well as a large perforation in the hard palate. In that case, as in Mr. Tawse's, the Wassermann test was negative, and no history of syphilis was obtainable, yet the lesions were very much like those due to syphilis. This patient was treated with "606," but no progress whatever ensued. Dr. Lieven felt certain, in spite of the negative Wassermann, that the lesions were those of tertiary syphilis. The patient got worse, small indurated swellings appeared on the muscles of the limbs, and he died. Post mortem, the *Bacillus mallei* was found, and the case proved to be one of chronic glanders. He (Mr. Tilley) had asked Mr. Tawse's patient and her husband whether they had had anything to do with horses, but they had not. There were also those types of cases which Semon had described as malignant syphilis, i.e., cases of tertiary syphilis, which, however, did not respond to large doses of iodide of potassium or mercury. Mr. Bell Tawse had told him (the speaker) that iodide of potassium made his patient's lesion worse. Possibly such cases might improve with inunctions of mercury, but if they did not do so, Zittmann's decoction of sarsaparilla might be tried, because Semon[1] had recorded two cases which responded to this treatment.

Sir JAMES DUNDAS-GRANT recalled a case he showed[2] of a young man whose pharyngeal lesions did not respond to antisyphilitic measures. He wondered whether there was some added infection, possibly tuberculous. Dr. Lieven, of Aix-la-Chapelle, recommended the intramuscular gluteal injection of a suspension of calomel in liquid paraffin. At the following meeting he showed this man after he had had that treatment, and his throat was practically well. Perhaps Mr. Bell Tawse would keep that treatment in mind. A soft rubber cover could be adjusted to the posterior margin of the dental plate she was wearing, as a protection from the food. If it was syphilis, probably the ulceration was more extensive on the upper surface of the palate than on the visible part. In the old days, solid nitrate of silver was applied to such ulcerated surfaces.

Mr. T. B. LAYTON said that if the Wassermann test had not been available, all would have felt confident this was a gumma. He submitted that none of the Wassermann tests that had been done in this case were of any value, as on every occasion some antisyphilitic treatment had been given within the previous month. This being so, the only evidence against this being a syphilitic lesion was invalid.

Concerning dosage, twenty years ago if one had trouble with the administration of iodide of potassium, the dose was doubled; and he suggested that in the present case, instead of giving 30 gr. three times a day, 60 or 120 gr. thrice daily should be given. He supported the giving of liquor sars. co., as advocated in certain cases in the days before salvarsan.[3]

Sir WILLIAM MILLIGAN said that recently he saw a very severe case of foot-and-mouth disease in a lady. She lived in Cheshire, and was very fond of animals, and the disease was subsequently found among animals on her property. There was very serious ulceration, which had penetrated to the bone, though it was only superficial on the palate. It was the only case of the disease he had seen in the human being, and he would like to know whether the present patient had been in the way of contracting foot-and-mouth disease. To him, however, it looked like a tertiary syphilitic lesion.

Dr. L. POWELL suggested that this lesion was a simple atrophic ulcer. He thought many people were fond of diagnosing syphilis without sufficient cause. He had seen, not long ago, a similar case in an old man, who also had ethmoidal trouble, and a continual discharge on to the floor of the nose, which was enough to cause ulceration to start and spread through. He watched that patient for a long time, and there was never any sign of growth, or anything suggesting gumma; it was simply a clean hole, from which sequestra issued from time to time.

Mr. E. D. D. DAVIS suggested that a guinea-pig be inoculated and the result noted. This case suggested tuberculosis or lupus.

Mr. W. IBBOTSON said he thought this was some form of tuberculosis. The undermining ulcer was suggestive of that disease, and there was some connexion between the nasal region and this ulcer; therefore it would be well to investigate the bacteriology of the nasal sinuses.

[1] "Some Unusual Manifestations of Syphilis in the Upper Air Passages," *Brit. Med. Journ.*, 1906, i, p. 61.

[2] *Proc. Laryng. Soc. Lond.*, 1906, xiii, pp. 33, 44.

[3] Cullingworth, *Brit. Med. Journ.*, 1906, i, p. 791, "First Report on Treatment of Venereal Diseases in the Army," 1904, p. 32.

Sir STCLAIR THOMSON said that for many years he had taught that a perforation of this sort through the hard palate must be due to either syphilis or traumatism. He did not remember having seen a case of lupus which had perforated the hard palate and in which there were no symptoms of lupus elsewhere.

With regard to the question of the Wassermann test, he asked whether any Members had had an experience similar to his own, in which a negative Wassermann reaction was reported twice or three times, and then a colleague emphasized the necessity of having the cerebro-spinal fluid examined. That examination was refused; later, the patient returned with early symptoms of tabes, and then the Wassermann test of the cerebro-spinal fluid was positive. There were cases of the kind which would resist every treatment.

He saw this present case a month ago, and, among other things, he suggested that the patient be put to bed while undergoing her antisyphilitic treatment.

Dr. W. H. KELSON (President) said it must be admitted that with long experience one did get a certain number of undiagnosed cases, which he was in the habit of calling those of simple spreading ulceration; cases in which antisyphilitic treatment had completely failed, as well as every other form of treatment. These cases showed destruction up to a certain point, and after that, the patients got well. He thought that by collecting and comparing notes of these, important deductions might be made.

Mr. BELL TAWSE (in reply) said he would have the complement-fixation test done for glanders, and he would give Zittmann's sarsaparilla, as suggested. He had already had an obturator made for the patient. There was not any ulceration in the floor of the nose now, but there was a month ago. He was disinclined to give as much as 120 gr. of pot. iod. three times daily. Nottingham and the county was a prohibited area at the moment for foot-and-mouth disease, but there had been no cases of it there for the past twelve months. This patient lived in the town. He intended to have ultra-violet rays applied direct to the palate, also to the body generally. An examination of the nasal contents showed the predominant organism to be pneumococcus. He would have the Wassermann done on the cerebro-spinal fluid, and report the case later.

An Instrument for the Application of Diathermy to the Œsophagus.

Shown by A. J. WRIGHT, F.R.C.S.

THIS is a further development of one shown at the meeting in December, 1924.[1] In principle, it consists of a Jackson's bougie with an annular terminal at the proximal end of the bougie portion. This, being slightly larger in diameter than the bougie, enables the diathermy current to be applied to the stricture from below upwards, thus avoiding risk of damage to healthy tissues. A needle or disc terminal can also be fitted.

Discussion.—Sir WILLIAM MILLIGAN said that this was a distinct addition to the laryngologist's armamentarium; he thought it would enable the operator to surmount many difficulties. A great advantage was the little rubber stilette at the end of the bougie. After locating the lesion, the subsequent movement was a retrograde one, which meant that one had much more control over what one was doing than when a forward movement was required. A further advantage was that it was always in the direct line of vision. Diathermy in the œsophagus he regarded as a risky procedure, but with this instrument the risks were much minimized. He wondered whether it was possible to make the stem of the instrument more rigid.

Mr. SOMERVILLE HASTINGS asked whether Mr. Wright had watched these cases after the application of diathermy, and if so, whether there had not been a complete fibrosis and occlusion of the œsophagus after the destruction of the growth by this means. He had found this a real difficulty when using radium, and he asked whether it was thought desirable to do a gastrostomy before treatment by diathermy was undertaken.

[1] See *Proceedings*, 1924-25, xviii (Sect. Laryng.), p. 7.

Mr. WRIGHT (in reply) said that he had used this type of electrode in a considerable number of cases, and, so far, without any fatality; he was pleased with the results he had obtained. Radium was not possessed by his hospital, and getting radio-active tubes was expensive; at present he was using diathermy in association with other things, such as Souttar's tubes. If one could get through the stricture at all, it was easy, with this type of terminal, to feel the lower end of it and pass it through. Then if the current were turned on and steady traction maintained, the sharp knife-edge would cut through. It was easy to perceive when one had finished the application, and the instrument could be employed without running unjustifiable risk. It was a great help to use a large tube, and to stop when one had cut through the stricture. In the earlier types he found that the heat of the terminal damaged the bougie, and the makers of this instrument had inserted a disc of a material which would stand the heat. It could be made more rigid, but he did not require it to be so. It had been kept small, and there was quite a light cable.

Nasal Polypus showing the Structure of a Glioma, from a Patient suffering from Cerebral Tumour.

(*Specimen and Lantern Slides.*)

Shown by DOUGLAS GUTHRIE, M.D.

CLINICALLY, the growth appeared to be the ordinary type of nasal polypus and only on microscopic examination was its real nature revealed. The patient, a well-built man, aged 46, previously healthy, was struck by a falling beam of wood in 1911 and sustained slight concussion. Next year, there gradually appeared paralysis of the right arm and leg, and this has persisted. There was also slight facial paresis. Headache has been present and has sometimes been severe, but vomiting has only occasionally been noted. The Wassermann reaction was negative, and potassium iodide, given for a long time, had no effect. No optic neuritis. The condition was diagnosed by a neurologist as glioma of the left frontal lobe of the brain.

In 1920 he became unconscious and remained so for five days, but gradually recovered. His mental outlook was altered and he became childish and emotional. In 1920, and again in 1921, a polypus was removed from the left nasal cavity. In 1925, symptoms of left nasal obstruction reappeared, and the observer removed with Luc's forceps a growth the size of a hen's egg, which burst and discharged serous fluid during removal. It appeared to originate above the attachment of the middle turbinal. Subsequent history was uneventful. Microscopic examination shows the typical appearance of a glioma, the free surface being covered by ciliated epithelium. The interior of the growth is œdematous, and the centre is excavated by a large cyst. At several points small hæmorrhages have occurred.

The two curious features of the case were the intranasal extension of a glioma of the brain and the fact that no meningitis had followed its removal. The patient was not only relieved of nasal obstruction, but of the headache which made his life a misery. The diagnosis hinged entirely upon microscopic findings, as shown by a series of photomicrographs to illustrate the typical "glia" cells, of tapering shape and with the nucleus at one end. Those were well seen in all the sections.

Sir JAMES DUNDAS-GRANT said he had recently had a case which illustrated a point in connexion with this specimen, namely, one in which there was a sarcoma extending from the ethmoid region into the brain. There were also polypoid growths into the nose; these he removed time after time, and could get no evidence of malignancy in them. The present case showed the need for caution in assuming that there was no malignancy in these conditions. Grünwald had emphasized that in malignant disease of the sinuses there might be ordinary polypoid and inflammatory outgrowths into the nose which showed no signs of malignancy.

Dr. DOUGLAS GUTHRIE also showed slides from a fatal case of rapidly-growing glioma of the frontal lobe, under the care of Dr. Norman Dott, in which there was found on post-mortem examination a downward extension of the tumour into the ethmoidal region, causing a deep depression, but no perforation, of the cribriform plate.

[Notes of the cases, with illustrations, will be published in the *Journal of Laryngology*.]

Swelling in the Pharynx.

By N. E. KENDALL, F.R.C.S.Ed.

GIRL, aged 21. Swelling on lateral pharyngeal wall on the left side, which extends into the naso-pharynx and down to just above the arytænoids. First seen ten months ago. No pain, no difficulty in swallowing and no perceptible change in size. Suggestions as to diagnosis and treatment.

Discussion.—Mr. T. B. LAYTON said he did not suppose any Member would know what was the nature of this swelling until it had been cut out. He suggested that it might be a parotid tumour arising from a salivary or other gland in the lateral wall of the pharynx. He had seen one case beneath the tonsil, and another in the soft palate. Apparently it was non-malignant, and it was tense and elastic. He recommended that it be attacked *via* the mouth, under intra-tracheal anæsthesia; he expected it would shell out with fair ease, though there was a possibility of the capsule bursting in the process.

Sir JAMES DUNDAS-GRANT said he thought this must be a malignant growth, probably sarcoma. There was a discrete enlarged lymphatic gland behind the angle of the jaw, which was disconnected from the parotid gland, and it was a question whether this ought not to be removed for microscopical examination, or whether radium might be tried.

Mr. NORMAN PATTERSON said he considered that the swelling in the pharynx and that in the neck were one and the same thing, and he would be inclined to attack it from the outside, whatever its nature.

Mr. F. H. DIGGLE suggested that this tumour be left alone. The patient had noticed it five years ago, when she had her tonsils removed, and it was only recently noticed by her doctor, when she had a sore throat. His own view was that it was a lipoma. A number of these cases were seen in which the lateral wall of the pharynx was displaced inwards.

Dr. DOUGLAS GUTHRIE said that still another possibility in diagnosis was the rare tumour originating from that tiny ductless gland—the carotid body.[1] He had seen one case which closely resembled that shown at present; it could be distinguished from the commoner mixed tumour of this region only by microscopic examination. Growth was very slow in his (the speaker's) case; the tumour had hardly altered since coming under notice three years ago, and caused the patient little inconvenience.

[1] *Journ. Laryng. and Otol.*, 1924, xxxix, p. 635.

Section of Laryngology.

President—Dr. W. H. KELSON.

Case Showing Re-formation of Frontal Bone removed eight years ago for Acute Osteomyelitis.

By W. M. MOLLISON, M.Ch.

W. B., AGED 23, shown in 1917 shortly after operation for osteomyelitis; at that time pulsation of brain could be felt all over the forehead. Now firm bone has been formed and the deformity is much lessened.

Discussion.—Mr. HERBERT TILLEY said he had been accustomed to remark that when osteomyelitis began before there had been operative interference, the patients often recovered after removal of the diseased bone, but if the osteomyelitis was secondary to operative interference, operation practically never succeeded in saving life. He was glad to see that the present case constituted an exception to that prognosis. He (the speaker) had seen extraordinarily extensive cases, in which the inflamed dura mater was adherent to the brain substance, and in trying to remove the diseased bone both dura mater and cortical substance came away with it (vide *Brit. Med. Journ.*, July 7, 1917). The result in the present case was excellent, and he (Mr. Tilley) wondered whether at some time there would be a complete covering of the dura by bone. He had seen cases of this kind in which apparently nature was intent in thus protecting an exposed area.

Mr. NORMAN PATTERSON said he had had one case of osteomyelitis of the frontal bone following several operations on both frontal sinuses, in which the patient eventually made a good recovery. That was many years ago, and the patient was still quite well.

Mr. MOLLISON (in reply) said that this case was one of pre-operative osteomyelitis, and he showed the patient because the frontal bone had extensively re-formed. The surgery text-books led one to believe that membrane bone did not re-form. Perhaps the re-formation in this case was largely due to the fact that the patient's age was only 14 at the time of operation. He (the speaker) used to be of Mr. Tilley's opinion that post-operative cases were almost invariably fatal, but in the last five years he had had three cases of post-operative osteomyelitis which he had treated successfully. In the case of one boy, whom he had shown soon after the operation, part of both superior maxillæ and all the ethmoid and nasal bones had to be removed, but there had been a good recovery.

Paralysis of the Left Vocal Cord with Dysphagia for Liquids.

By DAN MCKENZIE, M.D.

PATIENT, female, aged 59, first seen June, 1923, complaining of huskiness of voice and difficulty in swallowing liquids of several weeks' duration. Hoarseness preceded dysphagia by a few days—referred to a "cold" from sitting in a draught. Dysphagia affects swallowing for liquids only—consists in spluttering and choking.

Examination reveals paralysed left vocal cord. No other indication of disease discovered during two and a half years under observation. Arytenoid easily moved by probe. No loss of pharyngeal or laryngeal sensation. No evidence from X-ray or direct examination of any disease in the thorax or œsophagus.

Discussion.—Dr. WILLIAM HILL asked whether it was certain in this case that there was no paralysis of the inferior constrictor, or perhaps of some of the muscles serving the hyoid bone. He (Dr. Hill) did not think that mere paralysis of the vocal cord sufficed to account for this condition. He (the speaker) assumed that anatomical stenosis had been negatived by the exhibitor. Was there any myasthenia gravis in the case? The action of the palate did not suggest its paralysis.

Mr. J. F. O'MALLEY said one did not usually see difficulty in swallowing associated with ordinary recurrent paralysis. What was supposed to be the cause of the paralysis in this case? He (the speaker) had had a case with a history of hoarseness for nine years, and difficulty of swallowing for six months. He (Mr. O'Malley) had found paralysis of the left recurrent laryngeal nerve. The radiologist's report was that this paralysis was attributable to a tuberculous lesion in the left apex which, resulting in a pull on the œsophagus, had caused the dysphagia. He thought there was nothing of that kind in the present case, but there might be a lung lesion.

Mr. N. S. CARRUTHERS said he had had a similar case three years ago. The patient, a male, aged 45, had had a fixed left cord, and there was difficulty in swallowing fluids. He (the speaker) had diagnosed either aneurysm or growth, and gave a bad prognosis, but within nine months the cord had regained its movement, though the difficulty in swallowing had persisted for another six months. He (Mr. Carruthers) thought it must have been neuritis of a central origin.

Dr. D. A. CROW referred to a case of dysphagia which he thought had a bearing on the one under discussion. Late one evening he was sent for urgently to see a girl of 15 who was said to be unable to swallow, and only to be able to breathe with difficulty. Her doctor gave him the history of a feverish attack a week previously which had quite subsided; two days previously the patient had begun to experience difficulty in swallowing, which was noticed immediately after a breakfast consisting of haddock. On examination with the mirror, there was a pool of saliva surrounding the arytenoids, as in a case of œsophageal malignancy or of foreign body. There was no definite laryngeal paralysis, and the only breathing difficulty was that due to the saliva overflowing into the larynx, and not being satisfactorily cleared by coughing. With this history, though it did not strongly suggest a foreign body, he (the speaker) thought it best to exclude the possibility, and therefore passed an œsophageal speculum under a general anæsthetic. Breathing was shallow and there was some cyanosis, even before the introduction of the tube. There was no foreign body or any other abnormality to be seen, and the patient was returned to bed with instructions to lie in the prone position so as to drain away the saliva, while further measures to relieve what they (rather uneasily) diagnosed as a spasmodic stricture were postponed to the following morning. At 6 a.m., to their surprise and dismay, she collapsed and died. It then became obvious that the feverish attack a week previously had been due to a poliomyelitis of the medulla, affecting the swallowing, coughing and finally the heart centres, but strangely enough omitting the laryngeal mechanism, and that he had failed to distinguish between a spasm and a paralysis of rapid onset.

He (Dr. Crow) believed the present case must have been one of the same character, much milder in its nature, and much more usual in type, in that the larynx was also involved. And if so, he thought the dysphagia could be explained as an independent paralysis, and not as the result of the laryngeal paresis.

Dr. DAN MCKENZIE (in reply) said there was no arrest of solids at any spot, but as liquid passed over the orifice of the larynx some went into the larynx and set up coughing. There was no other sign of paralysis but that of the left vocal cord, and he (the speaker) did not see why the dysphagia should not be due to that paralysis. The only point against that view was that the combination had not been observed previously. If in the act of phonation the cords and the arytenoids did not approximate, so in swallowing closure must be imperfect also. The patient had been under observation for two years, and nothing else had been discovered. Perhaps if attention were paid to the matter, this kind of dysphagia might be found to be an occasional associate of simple, uncomplicated recurrent paralysis. But further observations should be obtained before generalizing. Had this been a case of nuclear poliomyelitis affecting the glosso-pharyngeal nerve, obviously the soft palate would have shown paralysis.

Irremovable Parotid Tumour (Perithelioma) of the Soft Palate and Lateral Pharyngeal Wall; treated by Radium and Diathermy.

By DAN MCKENZIE, M.D.

WOMAN, aged 35. Swelling over ramus of mandible first noticed two years ago. Rapid growth in throat during last three months.

Attempt at shelling-out from the pharynx having failed by reason of the attachment of the growth to the mandible and parotid gland, a tube of radium was inserted. Infection of the wound and tumour-area with considerable pyrexia followed, controlled eventually by diathermy-sterilization of the sloughing walls of the large wound-cavity. A few weeks later a second application of diathermy completed the destruction of the accessible parts of the growth. Since then the inaccessible parts have manifested diminution in bulk.

Mr. TILLEY asked whether the diagnosis of parotid tumour was based on microscopical examination of a portion of the original growth. He (the speaker) had not seen a true "parotid tumour" which had been for so long free from infiltration or ulceration, and in which the greater part of the disease was more obvious inside the mouth than externally.

Five Cases of Carcinoma treated by Diathermy.

By NORMAN PATTERSON, F.R.C.S.

(1) MALE, aged 69. Came to hospital, June, 1915. Cancerous growth of the right tonsil. Treated by diathermy. Subsequently extensive recurrence in floor of mouth and tongue with enlargement of cervical glands. Again treated by diathermy and operation on neck.

(2) Male, aged 63. Seen 1916 with extensive carcinoma of tongue. Mr. Milne had removed the glands on left side of the neck and tied lingual artery. Patient was transferred to exhibitor as a case unsuitable for ordinary surgical operation. The greater portion of the tongue was removed by diathermy.

(3) Male, aged 70. Carcinoma of tongue and floor of mouth. Growth involving anterior portion of under surface of tongue, mucous membrane of floor of mouth and over alveolus. Tumour was on right side but extended to middle line. Two soft glands near anterior border of sterno-mastoid, one on each side.

(4) Male, aged 63. Treated for carcinoma of tongue and floor of mouth. July, 1925, block dissection of glands on left side of neck, sterno-mastoid removed and external carotid tied. Subsequently, similar operation on right side followed by diathermy of the primary growth. On microscopic section the tumour and the glands on the left side of the neck were reported carcinomatous. The patient's weight has increased by three stone in the last six months. There is still a sequestrum to separate from the lower jaw.

(5) Male, aged 61. Carcinoma of soft palate and anterior pillar of fauces on left side.

July 10, 1923, diathermy of growth.

July 30, 1923, removal of glands left side of neck by complete dissection. Internal jugular and sterno-mastoid sacrificed. Microscopic examination—glands reported carcinomatous.

Discussion.—Dr. W. H. KELSON (President) said that in the early days of diathermy it was held that if a growth affected bone, or was even in close proximity to bone, it was not advisable to use this method. That statement had deterred him (the speaker) from operating in this way in one or two cases of the kind. There must be some modification of that view now, as one saw a number of cases involving bone in which diathermy had been employed with success.

Mr. C. A. Scott Ridout said that he had had one or two cases in which the bone was affected, and he had treated them with a long exposure to diathermy. Sequestra took a long time to come away afterwards, but the ultimate result had been very satisfactory. Had the exhibitor tied the external carotid artery before removing the malignant tonsils? He (Mr. Ridout) had done so, and there had been very little hæmorrhage at the time.

Dr. W. Hill asked what Mr. Patterson's practice was at present in regard to tying the carotid artery. He (the speaker) had sometimes tied it; but he had not had bad bleeding in the cases in which he had not done so. Some years ago Mr. Patterson and he had agreed that the game was not worth the candle as there had been bad bleeding despite the tying of the carotid. In one or two cases he (Dr. Hill) had gone right down to the bone with diathermy, and in one case the result was not good; possibly it was a case he should not have tackled in that way. He now thought diathermy would deal satisfactorily with cases which extended to the bone.

Sir StClair Thomson said that twenty years ago such patients as these would have been in a most pitiable condition. If any operation had been attempted in those days it had been attempted by the general surgeon, and it was greatly to the credit of laryngology that this improvement had been effected by laryngologists themselves. One of these cases had been referred to Mr. Patterson because even as late as 1916 the surgeon thought it unsuitable for operation. Members would remember Sir Henry Butlin's work on the tongue, and how hopelessly such cases were regarded unless the growth was on the side or else on the tip of the tongue. The advance was also a great one for the benefit of the working man. It was not sufficiently realized that a workman had only one standard: he must either be fit to work or not fit to work. The men thus treated by diathermy were enabled to continue to support themselves and their families for at least a few years longer.

Dr. Dan McKenzie said that obviously a new chapter was opening in the already large volume of laryngological operations, because laryngologists were now tackling tongue cases. As to the tying of the external carotid artery, he (the speaker) did not think it was important, especially when one was removing the glands. Still, it gave one a feeling of comfort for some time afterwards, because one felt that there would not be arterial bleeding. He, himself, always tied the external carotid; the procedure did not add to the gravity of the operation.

Mr. J. A. Gibb asked whether Mr. Patterson dissected the glands before the operation. Spread of cancer of the tongue occurred very early indeed, and when a case was successfully treated in the advanced stage there must have been considerable involvement of the lymphatic system of the neck.

Mr. Norman Patterson (in reply) said that Mr. Ridout had practically answered the question concerning diathermy treatment when the disease involved or nearly approximated to bone. It was not only the cases in which bone was involved, but one came across cases in which the growth was dangerously near portions of the jaw, the palate, or the internal pterygoid process. The bony sequestrum separated out afterwards, but it might be weeks, even months, before it came away. He had seen two years elapse between the diathermy and the separation of a sequestrum. With regard to tying the external carotid, some years ago he suggested this modification, and for that suggestion he was rather severely criticized at this Section. Still, he had persisted in the practice, and in the case of one-sided extensive growths he had gone so far as to tie the carotid on both sides. His habit at one time was to operate on the growth first, then subsequently on the glands; but more recently he had been doing the gland operation first, then, a fortnight or three weeks later, following on with diathermy. One great advantage of that was that there was an opportunity of tying the carotid on the affected side, and subsequently, if it was a large growth, of ligaturing the opposite carotid and carrying out diathermy at the same sitting. He felt greatly indebted to Sir StClair Thomson for his kind remarks about his (the speaker's) results. Most of these patients were actually working at the present time.

Section of Laryngology.

President—Dr. W. H. Kelson.

DISCUSSION ON ATROPHIC RHINITIS.

Mr. W. M. Mollison.

It has been an interesting task to read *some* of the literature on the subject of atrophic rhinitis; I say *some* because to read all that has been written would be a matter of weeks or months of hard work. I do not propose to inflict more than a résumé of the subject at this meeting, laying stress on some of the recent work.

At the outset we are met with the problem "What is Atrophic Rhinitis?" We all recognize there are at least grades of ozæna, and some cases of extreme atrophy without subjective symptoms. Chavanne examined 372 cases and divided them into two groups:—

(1) Cases of "simple atrophic rhinitis," atrophy of the inferior turbinals and only slight crusting; this group numbered 30 per cent.

(2) Cases of pure "ozæna," 70 per cent; among these, 70 cases were unilateral with deflected septum.

I propose to deal with the latter group, ozæna, characterized by atrophy of the mucous membrane and turbinated bones—notably the inferior turbinate, the presence of crusts and a typical highly unpleasant *objective* smell. The patient's sense of smell is usually absent.

Ætiology.

Controversy has always existed as to the cause of ozæna: many suggestions have been advanced, but it seems doubtful if any one common cause is to be found; there are so many predisposing factors, each of which may appear all-important. One fact does stand out: whatever the cause, the final scene is the triad of symptoms; and it is the dreadful social disability from which the patients suffer that has led and still leads to the search for efficient forms of treatment; the author of every treatment always appears to be a confirmed optimist.

After studying the various theories on the causation I suggest the following grouping:—

(I) *Anatomic theory:* racial and familial.

(II) *Infective theory:* (*a*) general infections, e.g., syphilis, tubercle; (*b*) local infection, from accessory sinus suppuration or from a specific organism.

(III) *Endocrine theory:* some trophic change in the nasal mucous membrane, laying it open to infections.

(I) The *Anatomic theory* suggests that undue breadth of the nose is the primary cause, and that crusts and atrophy follow as a consequence. This has been denied (as have all the theories).

Cisler investigated 150 cases and could not find that the shape of the nose bore any relation to the disease.

Roy examined 5,000 negroes in Africa and Oceania and found no cases of ozæna. On the other hand, he found Chinese and Japanese prone to the disease. He found, too, that of Indians, in the United States of America, those living in villages were more apt to develop the disease (6 per cent. have it) than those living scattered on high altitudes. In his opinion this fact supports the infective theory of ozæna.

The fact that the disease is so much more frequent among the hospital class does not conform to an anatomic theory, nor does the greater frequency in women. That

the disease occurs in families cannot be denied; it is when the cause of this fact is sought that controversy steps in.

Some insist that specific infection is the cause, others that syphilis or parasyphilis is to blame; others, again, that tuberculosis is the basis.

Perez is the champion of the infective theory, and quotes convincingly to that end. He found families

with	2	ozæna cases	56 times
,,	3	,, ...	22 ,,
,,	4	,, ...	13 ,,
,,	5	,, ...	9 ,,
,,	6	,, ...	2 ,,
,,	7	,, ...	2 ,,
,,	8	,, ...	once
,,	10	,, ...	once

He goes on to say that infection is always from man to man or from dog to man.

The following is interesting as showing how the disease attacks a family; but is an example in support of syphilis as the probable basis.

Viggo Schmidt examined the thirty-four children and the nurses in a children's home. Four children only were found to have typical ozæna.

(*a*) 12 years
(*b*) 10 ,,
(*c*) 9 ,,
(*d*) 4½ ,,
} Brothers and sisters

He also examined two other brothers from another home. (None of the other fifty-two inmates had ozæna.)

(*e*) 14 years, boy
(*f*) 8 ,, ,,

He found that a maternal aunt had ozæna. The mother had ozæna (died of aural meningitis). While the father died of aneurysm at 67, he had had syphilis before the birth of the children and his Wassermann reaction was positive. The seven children had all typical ozæna. All had negative Wassermann reactions: all flat noses: the author gave a good photograph showing all seven children, and their noses looked very similar with wide nostrils. They had, too, an alcoholic grandfather, while the father was syphilitic and alcoholic.

The history of this family is, as it were, a link between Groups I and II. My assistant, Mr. Davies, investigated the familial question and found some evidence in favour among the out-patients at Guy's Hospital.

Sacles investigated forty families; these numbered 200 individuals, of whom 150 were examined and of these sixty had ozæna.

(II) *General Infective Theory.*—It is obvious from these figures that familial investigation leads one to the second theory group—syphilis as the cause; indeed, syphilis almost ought to be included in the first group. The difficulty about hereditary syphilis is that so few cases of ozæna show a positive Wassermann reaction. Monlonguet, in 1922, found only 10 per cent. of cases with a plus reaction.

I have, on one occasion, seen a typical ozæna in a child under two, whose Wassermann was positive.

The negative Wassermann, however, should not be taken to indicate absence of syphilis; one may note the analogy of congenital syphilitic deafness where the Wassermann reaction is generally negative.

We then pass to Group II, section 2, *Tuberculosis and Ozæna.*

Alexander (1903) wrote on the connexion of ozæna and lung tuberculosis. He pointed out that of ozæna cases fifteen out of twenty-two, 68 per cent., had lung tuberculosis at autopsy. He showed that of 118 patients with healed tuberculosis, none had ozæna, but ten had atrophy of the turbinate mucous membrane. Also of fifty ozæna patients twenty-two had lung tuberculosis and seven were suspect; seventeen only were sound. Larger figures supported the connexion of ozæna and lung tuberculosis.

In 1916 Dan McKenzie, McKeith, and Wyatt Wingrave published their well-known paper to show that ozæna was tuberculous in origin, or at least had a very close relation to tuberculosis. Various tests were used on ozænatous patients.

Von Pirquet's test gave a positive result in 85 per cent. of cases and some general disturbance in 94 per cent. By means of injection experiments Wingrave produced tuberculosis in guinea-pigs, but never ozæna. Hypodermic tests carried out by McKeith yielded positive results in 94 per cent. of cases.

The authors treated cases with tuberculin; the treatment was long and tedious, but local improvement was seen in ten out of thirteen cases, as well as improvement in general health. The authors suggest that the acid-fast bacillus found in ozæna may really be a modified tubercle bacillus. They point out that ozænatous patients are generally in poor general health; in support of this statement there is Trimarchi's observation, that the blood of ozænatous patients constantly shows a lymphocytosis and often an eosinophilia.

Group II (*b*).—The next theory to be considered is that in which infection of the nose is secondary to suppuration in *the accessory nasal sinuses*. This view has always had supporters, but it does not meet the objection that cases begin in childhood before the sinuses are sufficiently developed; also examination of the sinuses, even in very marked chronic cases, reveals no pus.

Halpen and Schulmann pointed out "how many cases of ozæna there are without sinusitis; how many cases of sinusitis without ozæna; and, finally, how many operations have been performed on the sinuses without results." Grünwald (1893) considered that accessory sinus suppuration accounted for the foul smell, and published a series of cases in which he had operated on the sinuses with disappearance or change in character of the smell. Michel considered that the important fact was chronic suppuration in the accessory sinuses—especially ethmoid and sphenoid. Alexander (1903) thought Michel was wrong in stating that accessory sinus suppuration was present in every case, but that it was one important factor; he pointed out that children in whom the sinuses were absent might have crusts. Hajek considered a focus was, or might be, often present in ozæna, but that it had not been proved. Wertheim (1901) in cases of ozæna found the lining membrane of the sinuses infiltrated with many subepithelial cells and blood-vessels, but *never atrophic*. Lautenschläger has recently revived this theory, and has stated that microscopical examination of the lining of the antra and ethmoidal cells shows inflammatory changes, even though it is normal to the naked eye. On the strength of this observation he urged drainage of the sinuses as an essential step in operations for narrowing the nasal cavities.

The last section of Group II deals with the presence of a *specific micro-organism* which causes the changes characteristic of the disease. The evidence for and against such an organism is partly bacteriological, partly the result of treatment by vaccines. None but a skilled bacteriologist can assess the evidence—I certainly do not intend to try, but I propose putting forward the views that have been held:—

The specific organism has been said to be (1) the pseudo-diphtheria bacillus; (2) the Löwenberg-Abel bacillus; (3) the Perez bacillus.

(1) The early view was that of Italian workers, namely, that the organism was a pseudo-diphtheria bacillus, and Belfanti and others saw good results from treatment with anti-diphtheritic serum. This view was countered by Gradenigo and other authors who said they found no improvement with serum, or that if improvement occurred it was only temporary. Neufeld opposed that view, as he found pseudo-diphtheria bacilli in 98 per cent. of normal noses.

Taptas considered that the infection was due to the Klebs-Löffler bacillus, but that this became overgrown by septic micro-organisms. He injected the patient's blood under the mucous membrane of the inferior turbinates and floor of nose and septum and got good results in all out of twenty cases.

Malherbe and Dujardin-Beaumetz examined cases over a period of three years;

they found para-diphtheritic organisms and Friedländer bacilli on direct examination, while on culture the latter grew so freely that it made the para-diphtheritic organisms very hard to find. They found improvement after treatment by vaccines from the para-diphtheria bacillus alone; later examination showed diminution of the latter organisms in the nose, while the Friedländer bacillus remained. They suggest, therefore, that pseudo-diphtheria is the cause.

Recently Abraham (1925) found the Klebs-Löffler bacillus present in a series of cases; he records thirteen cases of atrophic rhinitis in which true diphtheria bacilli were found in the nasal cultures; eleven were females and two males. The ages ranged from 14 to 49. All the patients had the same symptoms, which consisted in nasal discharge of several years' duration, formation of crusts, headache, anæmia and lassitude. With the exception of one case of chronic rhino-pharyngitis sicca the clinical diagnosis was atrophic rhinitis. Infection of the nasal accessory sinuses was not present in any. Two patients had chronic otitis media. Two patients had suffered from diphtheria and another two gave a history of diphtheria in the family. Treatment consisted in administration of 4,000 to 6,000 units of diphtheria antitoxin for three days, combined with twelve to fourteen injections of an auto-vaccine prepared from an isolated strain of diphtheria bacilli, or in most cases from other organisms associated with the diphtheria bacilli, such as *Bacillus proteus* and *Bacillus mucosus*. The nose was also irrigated thrice daily with a ¼ per cent. solution of chloramine. Abraham concludes that a previous attack of acute diphtheria was the cause of the atrophic rhinitis in these cases. Similar cases had been previously recorded by Pfeiffer.

(2) Löwenberg and Abel, separately, found the *Bacillus fœtidus ozæna*, or *Bacillus mucosus ozæna*: subsequently this Löwenberg-Abel bacillus was stated to be *Bacillus Friedländer*.

(3) Perez (1899) wrote of *Coccobacillus fœtidus ozænæ* as being the specific organism. This bacillus had certain cultural characters—its cultures emitted the typical odour, and intravenous inoculations into guinea-pigs, &c., produced atrophic rhinitis with typical ozæna, and the bacilli were recovered from the nasal secretion.

Later (1901) he published more experiments. He also brought forward twenty cases in which the disease appeared to have been transmitted from dogs to men.

In 1907 Perez stated that "every case of ozæna starts from another case of ozæna or from the nose of a dog."

He divided cases into four groups:—

(*a*) Familial infection of eleven in a family, six had ozæna.
" " eight in a family, seven had ozæna.
(*b*) Non-familial infection, but from some other human infection.
(*c*) Canine infection, persons who lived at close quarters with dogs; children who played with dogs, &c.
(*d*) Unknown.

This theory put forward by Perez started a controversy which still rages. Among those in favour of Perez's theory are Hofer and Kofler, and among those against are Greif, Burchardt, Oppikofer and Neufeld. Hofer (1913), carried out Perez's technique by putting typical crusts into bouillon and then trying to separate the organisms. Shortly afterwards he found it difficult to distinguish the real Perez bacillus from the others; he chose patches of bacilli growing; he tried to differentiate type of organism; he found that the *Bacillus Löwenberg-Abel* grew so thickly that they obscured the other organisms and the coccobacilli could seldom be found.

He then experimented on dogs with intravenous injections of mixed cultures, and in twenty-four hours he discovered in the dog's nose pure culture of *Bacillus Perez;* in a few days, at post-mortem examination, the inferior turbinates were found to be

almost destroyed, with much secretion in the nose; in this secretion *Bacillus Perez* was found in pure culture (nearly).

He described the bacteriological characteristics. It yielded a quite typical smell. By injection with diluted cultures Hofer produced a serum which agglutinated with *Bacillus Perez*. Hofer and Kofler in 1914 published results of vaccine treatment which were satisfactory.

Safranek, in the Onodi Clinic, carried out injection experiments and was enabled to grow a culture from the heart blood and from this to produce (by intravenous injections) an atrophic rhinitis in the dog.

In 1916 these authors published the results of vaccine treatment; in nine cases they reported cures.

Greif only found Perez' coccobacillus in twenty per cent. cases. He did not consider it had specific affinity for the nose. He had found it in secretions from the trachea, bronchi, intestines, kidneys and conjunctiva. He found that injections of *Bacillus coli* and staphylococci gave the same results. He found no other local signs of ozæna on intravenous injections. Agglutination experiments with blood of patients proved negative. Horse serum yielded just as good results as specific vaccines and serum.

Burchardt and Oppikofer, in 1916, worked with a strain of Hofer's cultures of *Bacillus Perez;* they did not find the typical smell in cultures; they decided that *Bacillus Perez* was the same as the *Bacillus Abel*, and that both were really *Bacillus Friedländer*. They found no severe rhinitis on intravenous injection nor at post-mortem; no severe rhinitis, not even when the animals lived three months after inoculation. With large doses the animals died with septicæmic symptoms and local infection in lungs, pleura, pericardium, &c. Further, in 100 cases of ozæna they found no question of the patients having been near dogs. They suggested, too, that serum injections were not specific, but that any serum injection caused hyperæmia of the nasal membrane and therefore improvement. They denied the infectious nature of ozæna.

Neufeld set aside the Perez-Hofer bacillus and put forward the view that familial disease (through several generations) was the cause. He obtained some of Hofer's strain of *Bacillus Perez* and by inoculation produced rhinitic symptoms. In the secretion he easily found *Bacillus Perez*, and at post-mortem examination in four weeks he discovered much muco-pus in the nose and sinuses, but no atrophy of turbinates. In nearly 50 per cent. of ozæna cases Neufeld obtained pure cultures of *Bacillus Perez* from crusts. He had similar results with *Bacillus pyocyaneus*, *Bacillus paratyphosus*, *Bacillus diphtheriæ* and *Bacillus Friedländer*.

Salomonsen's findings were in opposition to all the work of Perez and Burchardt, and of Oppikofer and Neufeld. He failed to find *Bacillus Perez* in twenty-three cases. By means of inoculation, &c., he was unsuccessful in finding *Bacillus Perez* though he discovered one similar to it. He found no characteristic smell. Indeed he could not agree that any specific micro-organism was to be found.

Group III.—The Endocrine Theory—a fascinating theory, founded on physiology. Morell Mackenzie put forward the suggestion that ozæna was primarily due to some trophic change in the nasal membrane. Recently Halpen and Schulmann, reviewing the whole subject, put forward the suggestion that the endocrine theory covers most of the ground. They pointed out that Delaconi (1904) suggested that adenoids and ozæna occurred in those with hypothyroidism. They also pointed out that ozæna patients always have a strumous appearance; that the genital glands are undeveloped and that the hair of such patients is poor. Women provide more than half the cases, and three-quarters of them arise in puberty. The same authors see signs of internal secretion abnormalities, such as are found in congenital syphilis and inherited tubercle; thus patients suffer from acrocyanosis, low-tension pulse, sluggish reflexes, flushing and sweatings. The menstrual periods are often irregular (twelve out of

fifteen cases), the thyroid is enlarged (nine out of fourteen cases). They quote the case of a girl who suffered from ozæna, which disappeared as soon as her periods began. Also a case of Graves' disease with ozæna; treatment by X-rays cured the Graves' disease and the atrophic rhinitis at the same time.

They put down the affection of the nose to disturbance of the sympathetic control via the spheno-palatine ganglion; this ganglion, they state, contains the vaso-motor control of the nasal membrane as well as the secretory control fibres, and damage or paralysis of this ganglion system leads to lack of dilatation of the vessels in the nose, and this in turn damages the nose, particularly the most vascular part—the inferior turbinate.

Lastly, they point out that drugs which stimulate the sympathetic system do help to improve the nasal condition, namely, adrenalin, eserine and pilocarpine. They injected adrenalin into the spheno-palatine ganglion, and found that improvement resulted.

Liebault and Moers, on the supposition that ozæna is connected with disturbance of the sympathetic and endocrine systems, give adrenalin $\frac{1}{1000}$ by the mouth, 40-60 minims daily, and find that improvement takes place.

The interesting case recorded by L. Reverchon and G. Worms supports the endocrine theory.

A man aged 32 was wounded by a bullet in the right pre-auricular region, and the bullet was at once extracted through the mouth; the wound did not heal for some weeks. Six weeks after receiving the wound he began to have symptoms confined to right side of head, *facial spasms*, pains every day, but subsiding at night, so that they did not prevent sleep. The pain started in the deep zygomatic region or in the mouth or nose, radiated to the fronto-orbital region and to the vertex and even to the occipital region. The affected parts sweated a great deal. The attacks came on from very slight causes (as in trigeminal neuralgia). They gradually lessened.

Four months after the wound nasal symptoms were first noted:—

(1) A running of mucus from nose (right) without the patient realizing it. (2) Slight conjunctivitis. (3) Attacks of salivation after meals. After about eighteen months his wife noted foul breath. Ozæna was diagnosed.

The authors examined him in 1923, just four years afterwards, and they found:—

(*a*) Right facial anæsthesia. (*b*) Anæsthesia of right conjunctiva. (*c*) Abolition of sensation in right nasal fossa, of the palate, gums, teeth, right half of tongue. (*d*) Lessened sensibility of right membrana tympani, and the slightest touch of a probe produced very marked redness; hissing in the ear. (*e*) Slight atrophy of the masseteric and temporal regions. (*f*) Nose: foul smell, objective only; many green crusts from the right side—typical ozæna atrophy crusts. A perforation of the septum (trophic) with insensitive edge. The left side was normal.

Negative Wassermann reaction. X-ray showed fracture and a separated piece of bone deeply in zygomatic fossa.

These symptoms were those of the spheno-palatine ganglion syndrome. The authors mention two cases, published by Worms, of atrophic rhinitis following traumatic trigeminal paralysis.

After examining each of these theories one feels that there ought to be no doubt that the author is absolutely right—his arguments are so sound and convincing. But, fortunately, or unfortunately, cases crop up which undermine any theory. The following is such an one.

A young man about 20 was referred to me at Guy's Hospital in September, 1914. He was sharing a tent with several other recruits and the smell from his nose was such that his comrades could not support his presence. I found the left side of his nose normal, the right side very roomy, containing much greenish crust; far back was a darker object, a foreign body, a plum stone as it was shown to be after removal. This had been in the nose for about thirteen years, as far as the patient could decide. A few days after removal all smell had entirely disappeared and apparently the ozæna was cured.

A second case was also that of a hospital patient. She had been operated upon by an assistant for nasal obstruction and by some means the whole of one inferior turbinal had been removed. In three weeks she had a typical ozæna.

You have seen a third case to-day of ozæna due to irritation of a tooth erupting into the floor of the nose.

TREATMENT.

Treatment follows two main lines: (*a*) Vaccine therapy and local applications; (*b*) surgical measures to diminish the cavities or to restore the nasal mucous membrane to normal.

(*a*) *Vaccine Therapy and Local Application.*

Though these controversies have ranged round the question of a specific bacillus, the treatment by vaccines has been continued and lately developed along somewhat different lines from those made familiar to us all.

Fernandez Seco makes a vaccine from the predominant organism or organisms; he begins by giving doses of 100,000,000; he raises the doses to 8,000,000,000 and 9,000,000,000, and finds favourable results in 84 per cent. cases.

Rebattu and Proby make a vaccine with 4,000,000 to the c.mm., mix it with vaseline and smear it on the nasal mucous membrane before or after scarification.

Worms and Manovussakis combine vaccines in bouillons with an anti-gangrenous serum of Vincent and Stodel; they consider that anaerobic organisms play an important part in the causation of ozæna. They apply the mixture locally, either on gauze or by a spray, on alternate days. They see great improvement in less than twenty days.

Doniol-Valeroze also uses local vaccine treatment. His vaccines are made into a powder by Bergeron's method with lactose; added to powdered bile and insufflated into the nose in doses of 400,000,000 twice a day in fifteen days. There was an improvement in all nineteen cases. (Some of these had been given Liebault's vaccines without any benefit resulting.)

We may summarize all this by stating that local application of vaccines is the most recent method of vaccine treatment.

Other local treatments consist in applications of honey and glycerine which result in an acid medium unfavourable to the growth of the organisms (Tarneaud). Applications of scarlet red have also been used (Jacobi and Scal). Franchini has employed the nascent iodine treatment; he washes the nose with 6 volumes per cent. H_2O_2, and gives potassium iodide by the mouth.

(*b*) *Surgical Treatment.*

There is not much to add to what I found in reviewing the operative treatment of ozæna in January 1924.[1] There are three main types of operation:—

(1) Wittmaack's transplantation of Stenson's duct into the antrum to keep the nose moist.

(2) Lautenschläger's operation to open the sinuses and displace the outer wall of the nose inwards. A combination of (1) and (2) with Halle's modification and Seiffert's further modification.

(3) Operations to diminish the size of the cavities by introducing various substances under the muco-perichondrium or periosteum.

Some of these substances are in the nature of foreign bodies, paraffin, celluloid, &c.; others, cartilage or bone, or even simply blood. My own experience of inserting rib cartilage into the floor is not altogether satisfactory. Syme has performed Lautenschläger's operation and we look forward to hearing of his latest results. I have only performed this operation in one case, but, fortunately, the result was quite successful.

[1] *Journ. Laryng. and Otol.*, 1924, xxxix, p. 25.

Van Wildenberg is enthusiastic over Higguet's operation, which is an endonasal variation of Lautenschläger's operation.

Recently Bourak published his operation for inserting fat in the outer wall: he makes an incision under the lip freeing the soft tissues in the floor and outer wall below and above the inferior turbinal, pushing off the middle turbinal region together with a few ethmoidal cells. He then removes a piece of subcutaneous fat from the gluteal region and inserts it into the cavity thus made (the use of a needle and thread makes this easy). He gets good results within six or seven weeks: he claims the following for the operation:—

(1) It is easy, gives regular and sufficient diminution of cavities.

(2) After-treatment easy; better results than months of injections of paraffin, electrolysis, high frequency, light treatment or respiration exercises.

(3) Fixation of lateral wall inwards is obtained without damage of bony wall.

(4) The action of the fat provokes a prolonged reaction, prevents the continuation of the atrophy and stimulates regeneration in the cellular and glandular elements.

(5) It is satisfactory for unilateral cases.

Meurman reviewed the results of thirty-four cases in which Halle's operation was performed; they were fair, but in six of them the patients developed acute otitis media and one acute mastoiditis.

Other Methods of Treatment.

Almost every man has his own method, and, as I said above, each is an optimist. Kowler gives insufflations of oxygen under pressure; after ten sittings the mucous membrane recovers its normal appearance. Greif uses ultra-violet rays with a specially devised lamp; he cured a case that had resisted other treatments. Leroux-Robert found that half-minute exposures to high frequency currents killed cultures of *Bacillus Perez*; he therefore applied this treatment to the nose with good results. But it must be noted that he first painted the nose with formalin, the action of which set up a free secretion that washed away the crusts.

If one may sum up the subject crudely, the ozæna problem seems much where it was fifty years ago, and treatment is still symptomatic, except in respect of vaccines and surgery.

Sir StClair Thomson said that with regard to the question of the influence of the Perez bacillus, the way in which bacteriologists ranged themselves into two camps was very remarkable: one party being thoroughly satisfied that this bacillus was the *causa causans*, and the other maintaining that it had nothing whatever to do with the condition.

Had Members of the Section found ozæna getting rarer? Twenty-five years ago, at Golden Square Hospital, the cases seemed to swarm, whereas now they seemed to be comparatively rare. Was that due to a change in the disease incidence or to the fact that by recognizing syphilis and sinusitis many cases formerly classed as ozæna could now be weeded out?

With regard to tuberculosis, the ozænatous patient might become tuberculous for all he knew to the contrary, but during fifteen years at Midhurst sanatorium he had taken note of the condition of the nose of all patients there, and neither ozæna nor atrophic rhinitis was more frequent in the patients there than in the average population.

On the sex question there was general agreement, i.e., the great predominance of the condition in the female. It was also agreed that it began in early life. In that connexion his only contribution to this discussion would be to submit the notes of a well verified case. It had been suggested that atrophic rhinitis was not seen in elderly patients for the reason that, having felt the hopelessness of treatment, they withdrew themselves from it. That was a possibility.

In 1905, a young lady, aged 22, in good circumstances, consulted him because of the smell of her nose, which had been of several years' duration. The smell had been so offensive that no school would keep her. As she had complete anosmia she was not herself inconvenienced by it. She was strong, athletic and cheerful, and the condition did not seem to prejudice her health. It seemed to be typical ozæna; no neuralgia or headache. Though transillumination was good, he explored both her antra; they were clear. He had no suspicions of a kind to induce him to investigate further in the frontal or ethmoidal sinuses. The inferior turbinals were atrophied, and the repulsive odour was characteristic, what the Germans called "stinknase." The usual cleansing methods were used, and he saw her at intervals in 1909, 1910, 1911, and he could call Dr. Irwin Moore as a witness of the case, as he saw her in his absence. He (Sir StClair) had not seen her from 1911 to 1918, but Dr. Moore made a note that the condition was less ozænatous, and "more like atrophic rhinitis." He (the speaker) last saw her in January last year. She was now 41 years of age, and had remained unmarried. Menstruation was regular.

The reason of her visit was that she had become somewhat deaf; he removed the wax which was obstructing the meatus, and the ears were otherwise normal. She said that for three years she had given up the nasal lavage, the crusting in the nose had ceased, no one had complained of any odour for a long time, and examination showed that the Schneiderian membrane was almost sound, the turbinal surface normal, and that it was bathed in healthy mucus. She was now in a business house, and made no complaint of being ostracized, as she was at school. He was thankful he had not damaged her turbinals.

Mr. Mollison mentioned cases in which surgery conduced to ozæna, yet he (Sir StClair) had been struck by the fact that since he had introduced Moure's operation twenty years ago, the removal of every trace of turbinal was not followed by ozæna. So, apparently, in each case there must be, besides damage to turbinal tissue, some added infection.

Mr. J. F. O'Malley

said that Mr. Mollison had presented his résumé of the subject in a lucid and impartial manner. He (the speaker) had come to present a personal view, which to him was new, and therefore he submitted it with some trepidation after hearing what had been said. The ozæna of syphilis and tuberculosis could more or less be put out of the question, because when ozæna was due to either of these, some characteristic local lesion could usually be found. The view of the ætiology which needed special attention was the infective one. We were usually met with the objection that a nose might be full of gross sepsis and yet there might be no atrophic rhinitis, which was also absent when an operation had resulted in much destruction of tissue. He had built up his own view of the condition on the analogy in the case of lupus erythematosus. In that disease there were certain bilateral lesions, chiefly on the face, and the tendency of these lesions was to destroy the true skin. There was a heaping-up of dead cells and crusting, and when these disappeared there was destruction of tissue. A new idea had arisen that the lesions of lupus erythematosus were due to hæmatogenous microbic infarcts, and he (the speaker) had gradually arrived at the belief that this was also the case in atrophic rhinitis: the bilateral distribution and the tendency to occur in early life constituted a good analogy between the two, apart from the tendency for the condition to occur chiefly in females. If that was so, the site of the septic focus was not a very material point. The vascular supply determined the bilateral distribution, and then there were the tissue reaction and necrosis and the secondary infection. If the primary focus was in the nose, the condition would be much worse than if it was elsewhere; in the nose of man there was a far greater development of erectile tissue than in that of any other animal, the next greatest development being in the nose of domestic animals. The probability of infection from some animal such as the dog, which one authority mentioned by Mr. Mollison thought important, was, in his (Mr. O'Malley's) view, a likely source. Remarkable work had recently been done on tissue affinity and the selective activity of different organisms in these tissues. It would be interesting if

someone would make a thorough search and isolate some of the organisms from a case of atrophic rhinitis, especially from deep within the tissues, and inject them into the dog, in order to see if there could be discovered an organism with an affinity for the tissue of the nose.

Mr. W. Stuart-Low

said that with regard to the causation of atrophic rhinitis the environment had an influence, as was illustrated by many of his cases, such as that of a young female,—a housemaid with much dusty work to perform in a dry dusty atmosphere,—who improved on changing her surroundings to laundry work in a steamy, dust-free air.

Anything that tended to diminish the nasal mucus and make it sticky and gluey favoured the lodgment and development of micro-organisms. Such was certainly the case with regard to atrophic rhinitis. He had found useful, small doses of thyroid extract given over a prolonged period, as this stimulated the secretion of mucin in the nose which was certainly diminished in quantity and altered in quality in this intractable malady. His belief was that, if the mucous secretion in the nose and throat were perfectly normal in character, there would be no more atrophic rhinitis.

He also used mucin locally with most beneficial effect, namely, in spray and solution as a lotion: this was by far the best cleanser of the nasal lining.

He (Mr. Stuart-Low) could not entertain the view stated by Mr. Mollison that dogs were a medium for the origin and spread of this disease. Seeing how usual it was for children to play with dogs, if such were true it would be a very common complaint indeed, whereas it was becoming rarer and rarer. In fact he regarded the malady as now almost extinct, and this discussion somewhat posthumous.

He would mention the good effect of the application of actinic rays to the nasal lining. These certainly helped to prevent desiccation, and having great penetrative power, promoted the circulation of blood in deeper tissues and assisted leucocytosis, thus preventing the accumulation of crusts.

Dr. A. R. Friel

said he considered atrophic rhinitis with ozæna to be an example of a disease due to bacterial infection in an organ, which, owing to its structure with numerous recesses formed by the adjacent air cells, readily allowed a chronic condition to be established. The infection of the ethmoid was non-pyogenic, the cells were full of mucoid material containing a bacterium resembling a Friedländer bacillus as well as diphtheroid bacilli.

The main treatment consisted in giving a few doses of a vaccine of the Friedländer organism *intravenously* in doses of two to ten millions, and in opening the ethmoid cells by operation.

Mr. Norman Barnett

asked whether Mr. Mollison had had experience of the effects in this condition of ultra-violet rays. He had found that good results could be obtained by introducing the Kromayer lamp direct to the mucous membrane, by means of an applicator.

Dr. W. S. Syme

said he had seen many cases of this condition. He was not able to say whether the disease had decreased in frequency during recent years, but when one began to employ a particular method of treatment, cases which had resisted other methods were sent for attention.

With regard to causation he was favourably impressed with the theory that the parts of the body which came late in development were more apt to degenerate

under stress than were others. In mammalia the nose was the latest arrival in evolution, and in these days the stress was rather beyond the adaptability of the body to cope with it, that being especially true of the female sex, in whom atrophic rhinitis was commoner than in the male. While races remained in their primitive state, they kept free from atrophic rhinitis, and it made its appearance coincidently with their grouping under conditions of civilization. This also harmonized with the endocrine theory, endocrines being substances which provided the stimulus, enabling the individual to cope with modern conditions. He had not regarded the condition as inflammatory, due to the activities of a particular organism. He did not think that there was first an infection, and that then the state went on to atrophy; it was, he thought, primarily an atrophy. It must be very rare for unilateral atrophic rhinitis to occur.

Mr. Mollison had referred to the paper he (the speaker) read before the Section two years' ago,[1] relating his treatment of atrophic rhinitis by displacement of the antro-nasal wall. He had treated many cases by opening the antrum, separating the antro-nasal wall with a chisel. It was important not to make the breach in the nasal wall too low down, otherwise one encountered thick bone; one should rather aim at the lower part of the inferior meatus. After opening the antrum through the canine fossa, one should remove the external wall well forward. The displacement of the antro-nasal wall should be done, if possible, without injuring the nasal mucous membrane. Recently, after displacing the wall he had been putting in a doubled-up rubber tube; this exerted pressure on the lateral wall and kept it in position. He left the rubber tube in the antral cavity for a fortnight, the cavity being kept clean by douching.

A fairly constant result of this method was a return of the sense of smell. In some cases of atrophic rhinitis, by the way, the sense of smell was retained. In most cases some discharge remained, and he always prescribed a spray of formalin and glycerine, this being used as part of the toilet, as regularly as cleaning the teeth. After two or three months the result was good, but after a couple of years some retraction of the wall was seen to have occurred. But even at that time there was not the original tendency to crusting, and the objectionable odour did not, he thought, return. This displacement of the antro-nasal wall was the method which had given by far the best results in his experience, and it had the great advantage of allowing of an examination of the antral cavity. In a fair proportion of the cases, antral disease was present also. This might be the result of the atrophic rhinitis, or it might be primary in some cases, and indeed, probably was so.

Sir JAMES DUNDAS-GRANT

said he did not know any condition in regard to which there were such alternations of hope and despair as ozæna. He had had cases which seemed to illustrate all the various ætiological factors. For example, cases in which the bacteriologist found Perez's bacillus; under the use of vaccines the bacillus had disappeared, though the symptoms had not always done so. In two or three cases there had been a close association of the patient with dogs, and he thought this explained the origin of the condition, but he had more in which there was no such association. Also he had had cases which settled down with little or no treatment. In some cases the condition had cleared up after the patients had become married. Washing out the nose was a stand-by, and had given very great comfort. For cleansing the nose he liked to use sterilized water to which had been added spirits of sulphuric ether. This was a hypotonic liquid, and there was a tendency for it, by osmosis, to get through the turbinate body and cause it to swell. Plugging was useful, and many patients derived benefit from the glucose and glycerine application recommended by Mr. Benians.

[1] *Proceedings*, 1924, xvii (Sect. Laryng. and Otol.), p. 3.

Moure, of Bordeaux, described brilliant results following spraying out the nose with 1 per cent. solution of chloride of zinc. After its application a number of cases under his (the speaker's) care seemed to get well in a surprisingly short time but in subsequent ones the result was not so good. Injections of solid paraffin had been used with the idea of diminishing the lumen, but in some cases the symptoms disappeared after the introduction of such a very small quantity that no narrowing was produced, wherefore it seemed to exercise simply a stimulant action. He was of opinion that ozæna had recently diminished in frequency, and during the twenty years he had been at Brompton Hospital he had seen but few cases of it. There should have been more if tuberculosis had been an essential factor in causation. Expectation of curing every case would result in disappointment, but almost all the patients could be much relieved and some practically cured.

Mr. MOLLISON (in reply)

said it seemed that the facts adduced by most of the speakers supported the endocrine theory, and in his view that theory was more satisfactory than any of the others. The beneficial effect attributed to actinic rays might be due to their improvement of the general condition of the patient.

Section of Laryngology.

President—Dr. W. H. KELSON.

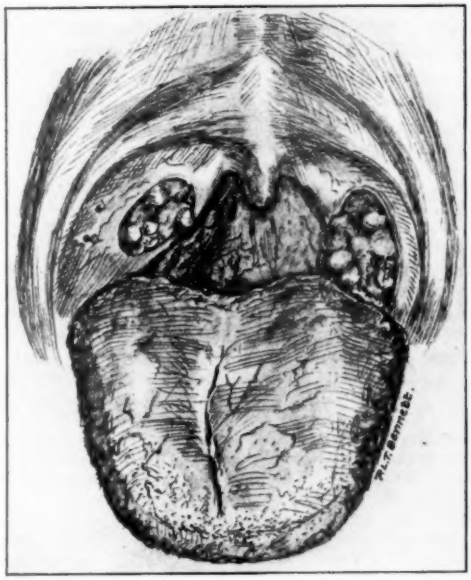
Case of Hypertrophied Tonsils with Multiple Outgrowths, probably Tonsillar in structure.

By Sir JAMES DUNDAS-GRANT, K.B.E., M.D.

MALE, aged 42. Frequent attacks of tonsillitis, one comparatively recent. Enucleation is proposed a little later.

A portion of the tissue from the left tonsil was removed on the possibility that it might be something other than simple growth. It was pure tonsil tissue.

Discussion.—Mr. HERBERT TILLEY said that cases of this kind had been shown before the Section from time to time. Many years ago Mr. Arthur Cheatle showed one, in which a pendulous growth hung from one of the tonsils. These growths generally originated from



the so-called "supra-tonsillar fossa," and they were found to consist of tonsillar tissue which took on a pendulous formation. A few years ago he himself showed a case almost identical with Mr. Cheatle's; it also consisted of tonsillar tissue. He once saw a case which looked exactly like the one now exhibited, and in this instance it appeared as if the lymphoid follicles were held together loosely by fibrous tissue supports.

Dr. W. H. KELSON (President) said he had seen a case presenting very much the same appearance as this one, but on section it turned out to be papilloma, though he did not suggest that the present case was of that nature.

Sir JAMES DUNDAS-GRANT (in reply) said he proposed to enucleate these tonsils, and perhaps he would be able to have a drawing made of the case beforehand. Such cases as Mr. Tilley referred to had been seen at the Section at times; but the present one was quite different, the great peculiarity being the multiplicity of the growths.

Case of Paralysis of Right Vocal Cord.

By F. J. CLEMINSON, M.Ch.

FEMALE, aged 49. Hoarse four months. No cause for paralysis found in neck or thorax. Probably due to pressure on right vagus from basilar meningitis of specific origin for which patient is being treated by Dr. D. McAlpine (by whom she was referred for a report on the larynx). Wassermann +. Occasionally recently a weakness of the right side of the palate has been observed.

I show this patient because I do not often see right-sided paralysis of the larynx. But last week I saw another patient who, eleven years ago, was sent into the country for a rest because his medical adviser was suspicious of the condition of the apex of his right lung. Lately he has had "acute laryngitis," has lost his voice, and I found his right cord was paralysed. But it was not in the cadaveric position; it was in the position of complete adduction, and I was doubtful as to whether it might be a paralysis which was of old standing, or whether, in view of its position, it was a recent one. I could find no cause for it in this instance. In the case I now show, the lesion is said to be basilar meningitis of syphilitic origin, and though the soft palate has been observed from time to time to show a little weakness on the right side, it was not noticeable when I saw her last.

Sir JAMES DUNDAS-GRANT said that a noisy stridor was said to occur when the patient was asleep. It could be explained by the extreme flaccidity of the right ary-epiglottic fold, which was remarkable and unusual.

Case of Double Abductor Paralysis.

By LIONEL COLLEDGE, F.R.C.S.

MALE. Presented himself four years ago (then aged 70) in respiratory distress from double abductor paralysis, apparently of rapid onset in the course of ten days and requiring tracheotomy. The tube was worn for eighteen months, when it was discarded, because it was found that the left cord had become cadaveric, leaving sufficient space for the patient to breathe comfortably through the glottis. The present condition is that there is abductor paralysis of the right cord, whilst the left is cadaveric. No cause has ever been found for the laryngeal paralysis.

Discussion.—Dr. IRWIN MOORE said that this case was an example, and a very rare one, of Nature's "cure" of double abductor paralysis. In 1923 he went through much of the literature, and he believed that this was the first case of this character shown at a meeting of this Section. He doubted whether any Member had observed a case of double abductor paralysis in which the cord had passed from the mid-line into the cadaveric position. Of fifty-three cases of abductor paralysis recorded between 1892 and 1898, only six developed complete recurrent paralysis. Of the remainder twenty-two had unilateral and twenty-five bilateral abductor paralysis, showing how small a chance there was that the cords would reach the complete stage of paralysis (cadaveric position). He asked whether any of the senior Members had ever seen this occur after the performance of tracheotomy. It was interesting to note that, in the case now recorded, eighteen months elapsed before the stenosis was relieved by the cord passing into the cadaveric position, and the tracheotomy tube could be dispensed with.

He did not think that there was complete fixation of the cord in this case.

Mr. COLLEDGE (in reply) said that he had not seen the patient for six weeks. He had been under observation four years, and the swelling, now evident, had appeared since he saw the patient last. Therefore the picture now differed from that described in the notes. He showed the case because he had been able to trace the passage of the position from adduction

into the cadaveric position. Some French writers had recently cast doubt on Semon's law, and this patient seemed to illustrate it very well. He had not yet formed an opinion as to the character of the recent swelling. He would show the patient again.

Subsequent History.—The patient later had some recurrence of dyspnœa and was therefore re-admitted to St. George's Hospital to have the tracheotomy tube re-inserted. He died suddenly on the morning when this was to have been done (July 21, 1926), by then aged 74, apparently of some acute cerebral condition. At the necropsy permission could not be obtained to open the skull, but it was found that the swelling was a simple cyst and the cords remained fixed in the same position as during life.

Case of Nasal Growth: for Diagnosis.

By ELEANOR LOWRY, M.B.

History.—The patient, a boy aged 12, is shown, with a question as to diagnosis.

He has complained of nasal obstruction for the last year, with epistaxis twice within the last six months.

He was sent to the School Clinic as a case of adenoids, but on digital examination under an anæsthetic it was found that he had a very hard, firmly fixed new growth almost filling the right choana. On examination with a nasal speculum, a red, granular growth was seen coming from the middle meatus.

Transillumination was slightly against the right antrum, but a skiagram showed the right antrum to be lighter than the left.

Mr. HERBERT TILLEY said he had made a digital examination of this boy's nasopharynx and found the tumour very hard. He did not regard it as a fibroma, nor an antral polypus, because in each of those conditions it was generally possible to detect some degree of elasticity, whereas this was a very resistant structure. He thought it was probably a cartilaginous tumour, possibly developmental in origin, or it might be a chondro-sarcoma growing from the pharyngeal orifice of the Eustachian tube. He did not know how the diagnosis could be settled unless the patient were placed under an anæsthetic, the surgeon being prepared to deal with the case according to what he found. He suggested that course. In regard to the method of access, he would prefer a modified Rouge operation, which would provide free access under the cheek and lip, and thus avoid cutting the facial tissues. The operation would paralyse the dental nerves which were involved in removal of bone above the alveolus. In order to get a free upward separation of the soft parts one must perform a laryngotomy for the administration of the anæsthetic, and plug the lower pharynx with gauze during the operation on the nasal and postnasal cavities.

He suggested that the growth was invading the posterior region of the nasal fossa, where one could see reddish and œdematous mucous membrane. Anyone who set out to deal with the growth should be prepared to have some trouble with free bleeding, and to minimize this difficulty a free view and good access should be obtained. He was convinced the growth was solid, but he was not so sure of its nature.

Mr. H. J. BANKS-DAVIS said that he gently examined this boy's nasopharynx and he did not agree with Mr. Tilley's impression of it. Admittedly it was hard, but very smooth, and might well be a nasopharyngeal polypus nipped in the posterior fossa, for some of these growths became very hard and adherent. Before attempting anything like a Rouge operation as suggested, he thought that with a finger behind the palate the tumour could be removed by traction through the nose under a general anæsthetic.

Dr. IRWIN MOORE said he had not made a physical examination of the postnasal space in this case, but to him the growth appeared to be an early nasopharyngeal fibroma. Some years ago Mr. Tilley had expressed the view that many of these fibromata originated from the spheno-ethmoidal recess, which was at variance with the generally accepted view that these growths arose from the special fibrous tissue covering the basi-occipital and basi-sphenoid bones. Their origin from this recess was possible, since the fibrous tissue extended to this recess from the postnasal space. He agreed with Mr. Banks-Davis that it should be possible to remove the growth, in this case, via the nose, and he suggested the use of a periosteal elevator designed by Mr. Thomas Guthrie, who had operated upon a number of these cases.

With this instrument—passed through the nose—the prolongation in the ethmoid region could readily be detached. He would be glad to lend the instrument to Dr. Lowry. He himself had recorded a case of nasopharyngeal fibroma which he successfully removed through the natural passages without having to open the face.

He asked that the case should be shown again at the June Meeting, so that opinions could be elicited from more Members than the Strike permitted to attend that day.

Postscript.—With the help of Mr. Herbert Tilley laryngotomy was performed on May 31, and the growth was separated from the outer wall and removed through the nose. On microscopical examination the growth was found to be a fibroma (Miss D. W. Hall, F.R.C.S.Ed.).

Points of interest.—(1) The slightness of symptoms from so large a growth. (2) Its accidental discovery during an operation for adenoids. (3) The extreme hardness, which simulated a chondroma or osteoma.

Case of Fibro-Sarcoma of Maxillary Antrum.

By H. Lawson Whale, F.R.C.S.

Boy, aged 13. Six months' history of swelling of right cheek.

Right eye.—Counts fingers only at 2 ft., well-marked optic atrophy. Slight proptosis. Ocular movements normal. Two pieces removed from the mass; the first through the nose, the second, a week later, through the canine fossa, were reported by the pathologist to consist of granulation tissue only. Nevertheless I propose to remove the whole upper jaw, except the hard palate.

Discussion.—Mr. Harold Barwell said he looked with the mirror at the postnasal space of this patient and found it full of a large, red growth, which, as Mr. Whale said, seemed to extend right across. He felt certain it was a malignant growth, and he counselled neglecting the pathologist's report. Apart from leaving it alone on the plea that it was too extensive—a view which he did not share—he thought the only course was to attack the growth through an external incision, such as for a modified removal of the upper jaw. This would at least give the patient a chance.

Dr. W. H. Kelson (President) said it occurred to him that the swelling might be osteitis fibrosa; that accorded better with the microscopical findings. It was the situation in which that condition often began, affecting first one jaw and then the other. It was generally painless and was occasionally found at that age.

Sir James Dundas-Grant emphasized the fact that often a malignant growth in the maxilla or in the neighbourhood of the nose was accompanied by the development of a large number of purely inflammatory outgrowths, looking like simple nasal polypi. These, when submitted to the pathologist, might be quite truthfully reported upon by him as innocent, though there might be malignant disease underlying the tissue removed for examination.

Mr. H. J. Banks-Davis suggested that before any extensive operation was done in this case, the Erlangen treatment—deep X-ray therapy—should be tried. It was surprising to see how under this treatment large tumours almost disappeared or become operable.

Mr. H. Lawson Whale (in reply) said that at first he thought it was polypoid. Polypi were often the heralds of more serious conditions underlying them. That was why, when he failed to get anything definite from the nose, he opened the canine fossa. There was no massive tumour to shell out; the tumour suggested a granulomatous overgrowth of the lining which could be got away with the curette. He explored by means of vision and the finger as far as possible. If it were osteitis fibrosa he did not think there would be a cavity in the bone. The growth did not close up the lumen of the antrum. There was no egg-shell crackling, and one had to use the gouge and mallet. To the feel, there were rather hard nodular lumps growing from the lining in all sorts of places. There was no more bleeding than from opening the antrum for any other condition, but there was a good deal of bleeding when he removed a piece for examination.

Later Note.—After the operation the pathologist reported the growth to be fibro-sarcoma.

Section of Laryngology.

President—Dr. W. H. Kelson.

SUMMER MEETING.

Nasal Sinusitis as a Cause of Toxæmia.

By Sir William Willcox, K.C.I.E., C.B., C.M.G., M.D., F.R.C.P.

"Toxæmia" is generally recognized, in this country, as the most important ætiological factor in the causation of disease.

When a disease is caused by an infection with a known specific organism such as typhoid fever, diphtheria, &c., it is obvious that the symptoms produced are the result of the toxæmia of the known infection. In the auto-intoxications caused by defective function of certain secretory organs—"uræmia," for example—it is apparent that toxæmia is the cause of the symptoms exhibited.

Diseases in which the proof or specific causal organism is less clearly demonstrable and in which there is no evidence of defective function of the important secretory organs, include by far the largest group of diseases, and most of the common ailments come under this category. For example: chronic rheumatic conditions, diabetes, hyperpiesia and arterial disease, the various forms of secondary anæmia, and possibly pernicious anæmia, many skin diseases, retinitis and many pathological eye conditions, asthma, gout, exophthalmic goitre, colitis, appendicitis, gastric and duodenal ulcer, some diseases of the central nervous system such as combined sclerosis, &c.

In most of these conditions careful search will reveal some definite toxic factor, and usually a definite focus of bacterial infection can be found which acts as a distributing centre for toxins and so brings about the toxæmia and its resulting effects.

In this country, the importance of the toxic factor in the causation of common diseases such as those specified is becoming more and more generally appreciated. There is strong evidence that the lead given by British Medicine in the realization of the great ætiological importance of focal sepsis as the toxæmic cause of many of the common and less understood diseases is being appreciated and followed in other countries.

Considerable attention has been paid during the past few years to the great importance of dental sepsis as the toxæmic cause of a large number of common diseases. It is fully realized that dental sepsis may not only lead to the formation of an acute local inflammatory lesion with the local symptoms of pain, swelling, abscess formation, &c., but that in a much larger group of cases the dental sepsis is latent as regards the production of local symptoms of pain, irritation, &c., and manifests its toxæmic effects by causing disease in other organs.

In other words, dental sepsis is commonly latent as regards its local symptoms and yet produces by means of its toxæmic effects profound pathological changes in other organs of the body. In 1923 I opened a discussion in the Section of Odontology of this Society on "Dental Sepsis as an Ætiological Factor in Disease of other Organs," and the part played by dental sepsis in the production of systemic disease was fully dealt with in that discussion.[1]

[1] *Proceedings*, 1922-23, xvi (Sect. Odont.), pp. 7-34.

All that has been said in regard to the effects produced by dental sepsis in the causation of disease of other organs applies with equal emphasis to nasal sinusitis.

A point of the greatest importance is that just as dental sepsis is often latent and can only be demonstrated by radiological methods, so in nasal sinusitis the existence of the focus of infection is quite latent in a large number of cases and gives rise to no local symptoms.

It is easy to overlook an existing nasal sinusitis in a case of chronic disease where other parts of the body are affected, e.g., arthritis or diabetes, unless special search is made.

In opening a discussion on "Fibrositis" on behalf of the Section of Medicine last year, I said that when no focus of infection was found the explanation as a rule was that the investigation had not been sufficiently complete and that a focus of infection would usually be ultimately discovered if the search was sufficiently exhaustive.[1] This applies with especial force to nasal sinusitis.

In a considerable number of my own cases in which the disease has been obviously due to a chronic toxæmia and in which no apparent focus of infection could be found, to my surprise a latent sinus infection has been discovered. In every case of this kind a systematic expert examination of the nasal sinuses is essential.

Nasal sinusitis is often co-existent with another focus of infection, and the presence of dental sepsis, for example, should not preclude a systematic expert examination of the nasal sinuses.

Diagnosis of Nasal Sinusitis.

In acute conditions the clinical symptoms are often sufficiently obvious. The presence of local pain and the neuralgia, of infra-orbital, dental, supra-orbital or frontal type, attracts attention. The œdema of the cheek, the unilateral nasal discharge and the presence of pus in the nasal cavity, with swelling of the mucous membrane make diagnosis easy.

In the chronic conditions the clinical symptoms may be entirely absent, and though in many cases inquiry will elicit the information of nasal discharge or swallowing of muco-pus, yet in a number of cases even these symptoms are not present.

Expert examination of the nose is essential.

Radiographic examination will often reveal opacity to the X-rays in the region of the affected sinus.

It must be remembered that the penetration of X-rays is quite different from that of light rays. A clear serous effusion or an œdematous mucous membrane will exhibit some opacity to X-rays but little to the light rays. Again, the thickness of the facial bones varies much in different patients. In a number of cases of latent sinusitis under my care there has been a discrepancy between the radiographic opinion, and expert opinion based on transillumination. Whilst radiographic examination is helpful and is of value in the diagnosis of nasal sinusitis it is not always decisive.

The diagnosis of the presence of pus in an antrum cannot be made with absolute certainty by radiographic examination alone. It is advisable, therefore, that reports should be restricted to statements of fact as to opacity of a particular sinus to X-ray. Conclusions as to the presence of fluid or pus should be avoided in reports.

Transillumination, in expert hands, is a valuable means of diagnosis in the case of antral infections, especially if accompanied by rhinoscopic examination of the nasal cavity. This method of investigation, however, does not appear to be always decisive. Variability of thickness of the facial bones, abnormal thickening of the mucosa, neoplasms, &c., may cause dimness and doubtful results.

Rhinoscopic examination accompanied by puncture of the affected sinus appears to be the only certain method of diagnosis in some of the latent cases. Examination

[1] *Proceedings*, 1925, xix (Joint Disc.), p. 28.

of the washings with sterile saline will reveal the presence of pus or bacterial infection. This method can only be employed by an expert rhinologist.

Transillumination is a method of investigation which, with a little practice, can be performed by every practitioner, and in cases of toxæmia of obscure origin it is desirable that it should be carried out as a routine procedure.

Where expert rhinological investigation is not immediately available examination both by X-rays and by transillumination should be carried out and if both yield a negative result in the case of antral infection it is probable that no accumulation of fluid is present in the cavity.

Organisms present.—In acute conditions usually the pneumococcus, the bacillus of influenza, or the catarrhal, staphylococcal, or streptococcal organisms commonly present in rhinitis will be found in the affected sinus.

In the latent conditions of sinusitis where systemic effects are produced in other organs, a streptococcus of the *viridans* group is usually found. This type of organism is remarkable for its peculiarity of producing little or no local inflammatory condition, though causing profound changes in other organs of the body by reason of the deported toxins.

Systemic Effects.—As already mentioned, nasal sinusitis may give rise to exactly the same group of diseases in other organs as those caused by dental sepsis.[1] It is unnecessary to recapitulate these.

Some illustrative cases may be quoted as examples:—

Cases of Acute Toxæmia.

(1) Mrs. D. G. had suffered from attacks of intermittent pyrexia and ill-health from July, 1918, to October, 1921. Paratyphoid fever and pelvic inflammation had been suspected, but findings were negative. Radiographic examination showed an apical infection of the upper left first molar tooth, and opacity of the left antrum. Removal of the infected tooth and nasal drainage of the antrum resulted in rapid and complete cure. Organism: *Streptococcus viridans.*

(2) Mrs. P.—In St. Mary's Hospital suffering from arthritis of the hands and acute pyrexia of three months' duration. The pyrexia was much too high to be due to the arthritic condition. Opacity of the right antrum was shown by X-rays and the diagnosis of sinusitis was confirmed by Mr. Cecil Graham. Puncture of the antrum was insufficient to control the pyrexia. After nasal drainage of the antrum the temperature immediately became normal, there was marked improvement in health and the arthritis was diminished. The patient increased 1 stone in weight within a few weeks. Organism: *Streptococcus viridans.*

(3) F. B., aged 18. For three years intermittent attacks of pyrexia, each lasting for several weeks. No evidence of pulmonary tuberculosis; both antra opaque to X-rays; rhinoscopic evidence of sinusitis. Organism: *Pneumococcus.*

(4) L. B., aged 16. Admitted to St. Mary's Hospital in state of collapse on May 18, 1926. Upper right first molar tooth had been removed, May 5, 1926. X-ray examination showed opaque right antrum. Nasal drainage by Mr. Graham. Right antrum filled with pus. Organism: *Streptococcus.*

Chronic Toxæmias.

(5) G. L.—Ill health for several years. Headaches and recurrent attacks of colitis. Both antra found infected. (Transillumination and rhinoscopy.) Treatment of the antral condition followed by great improvement in health. Organism: *Streptococcus viridans.*

(6) Miss S.—Ill health for four years. Frequent slight pyrexia in evening (temperature 99·5° F.). Both antra opaque to X-rays. Diagnosis confirmed by operation. Organism: *Streptococcus viridans.*

Pernicious Anæmia.

(7) Patient aged 58. Chronic antral suppuration caused by *Streptococcus viridans.* Operation accompanied by blood transfusion. Patient made marked improvement.

[1] See footnote p. 49.

Adenitis Resembling Lymphadenoma.

(8) W.—This patient gave a history of marked enlargement of lymphatic glands following an "influenzal" attack in 1921. Admitted to St. Mary's Hospital, April, 1925. Marked enlargement of glands of neck and axillæ and of glands in the mediastinum (shown by X-rays). Stridor was present. Microscopical examination of the glands showed a chronic inflammatory condition, with giant cells resembling tuberculosis. No tubercle bacilli found. Tests for tuberculosis negative. X-ray examination showed opacity of both antra and right frontal sinus. Operation by Mr. Graham followed by complete recovery. Organism: *Streptococcus viridans.*

Arthritis.

A considerable number of cases of this disease have been under my care in which the infective focus has been clearly antral (see Case 2). A recent remarkable case is worthy of mention.

(9) F. B., aged 18.—Lame for six months. Admitted to St. Mary's Hospital, February 15 1926. Marked arthritis of both hips with extensive bony changes shown by X-rays. Both antra opaque on radiographic examination. Suppuration of antra found at operation by Mr. Graham. Organism: *Streptococcus viridans.*

(10) Mrs. G. T.—Advanced arthritis, March, 1923. Admitted to hospital, April, 1924; had been practically bedridden for one year. Left antral infection found. Operation; improvement. Recurrence of symptoms. Re-admission, November, 1924. Left ethmoidal sinus infection found. Operation followed by cure of arthritis and good general health. Organism: *Streptococcus viridans.*

Diabetes.

I have had under my care a number of cases of diabetes in which the causative focus of infection has been an antral sinusitis. In these cases operation on the affected antrum has been followed by marked rise in the carbohydrate tolerance and improvement in the general health.[1]

One case deserves mention:—

(11) A. C., female, aged 23, mother of two children. Onset of severe diabetes August 11, 1923. Admitted to hospital September 21, 1923. Carbohydrate tolerance low. Five septic teeth removed, followed by improvement. Patient had recurrence of symptoms and was re-admitted to hospital February 26, 1924. X-ray of antra showed opacity on right side. At operation suppuration found. Drainage effected. After operation carbohydrate tolerance rose markedly. Glycosuria disappeared. This patient had increased in weight by 3 stone when seen nine months later. She had become pregnant. Organism: *Streptococcus viridans.*

Toxic Neuritis.

(12) K. R. D., aged 58. Seen May, 1926. For the past year has complained of tingling sensation in the hands and feet. The hands became first white and then blue (Raynaud's syndrome). Complains of discharge of matter from right nostril. Examination by Mr. Seymour Jones showed completely dark right antrum on transillumination, and on puncture thick pus was found. The symptoms seem clearly due to toxæmia from the focus of antral infection.

Early Bronchiectasis.

(13) H. G. W., seen March 12, 1925. Ten years previously an acute illness with pyrexia lasting two months. When this subsided tonsils were removed. Health improved for several years. In 1923 ill health with some pyrexia; infection of the maxillary antra found. The antra were operated upon and nasal drainage was effected. Health improved after this. On February 12, 1925, whilst in Germany, this attack of pyrexia lasted three weeks. A good deal of nasal discharge; much expectoration. Pulmonary tuberculosis suspected. On March 12, 1925: History of recent expectoration of large quantities of sputum in the morning. Area of dullness with crepitations at base of right lung. X-ray examination of chest showed signs of early bronchiectasis of right lower lobe. Sputum showed a heavy infection with streptococcus of the hæmolytic type. No tubercle bacilli present.

[1] Vide *Practitioner*, December 1923, "The Treatment of Diabetes."

X-ray examination of the nasal sinuses showed marked general sinusitis. Muco-pus was reported as coming from both antra and from both sphenoidal sinuses and from the right frontal sinuses.

Treatment: Rest in bed, with creosote inhalations and with inoculations of an autogenous streptococcal vaccine. The sinusitis completely cleared up and all the symptoms and signs of bronchiectasis disappeared after one month's treatment. Patient in good health since.

Retrobulbar Neuritis and Retinal Hæmorrhages.

(14) H. Y.—Seen September 30, 1924, *et seq.* In 1922 ethmoidal sinusitis followed by retrobulbar neuritis and retinal hæmorrhage affecting the right eye. Some dental sepsis. Treatment of the focal sepsis (dental and ethmoidal) has been followed by great improvement. Slight impairment of vision of right eye corresponding to the hæmorrhagic lesion remains, but apart from this the health is now normal.

Quite a number of cases of nasal sinusitis in medical practitioners have come to my notice. The reason of this must be that the patient who is aware of the possibility of this condition has recognized the slight symptoms and by calling attention to them has been fortunate in effecting an early diagnosis.

Conclusions.

(1) Nasal sinusitis is relatively common and should always be suspected and searched for in cases of toxæmia of all kinds where the cause is not apparent.

(2) In cases of systemic disease which may possibly be due to toxæmic condition, careful search should be made for any evidence of sinusitis.

(3) Nasal sinusitis is an important cause of toxæmia, and its effects may be very far-reaching and may cause any of the many diverse pathological conditions such as those now recognized as resulting from dental sepsis.

(4) Nasal sinusitis, particularly in chronic cases, often requires operative treatment. The value of the surgical treatment is much more than the treatment of a local anatomical defect or local pathological condition. Adequate treatment is imperative, since nasal sinusitis is a focus of infection which if left untreated will speedily give rise to serious systemic disease affecting other parts of the body.

(5) In the treatment of nasal sinusitis it should always be remembered that one is dealing with a case of toxæmia, usually streptococcal, where the focus of infection is in the nasal sinuses. Each patient is therefore a problem in immunity.

The management of every case should be based upon this view. When operative treatment is decided upon it must be remembered that an auto-infection will follow the surgical measures. In cases in which the toxæmia is acute it is therefore best to avoid operation if possible until the acute toxæmic symptoms have subsided.

In chronic cases not too much in the way of operative treatment should be done at one time so that opportunity may be given for recovery from the resulting auto-infection.

Where foci of infection exist in other parts, for example, the teeth or tonsils, it is well to allow a sufficient interval of time after a sinus operation before proceeding with the further surgical measures.

The human body is frail and requires gentle and careful handling in order that its immunity and resistance to toxæmia may be constantly on the up-grade when operative measures are being carried out.

Discussion.—Sir StClair Thomson said that he could produce evidence in support of all that had been stated in the foregoing paper. His (the speaker's) own experience with regard to diabetes and arthritis was limited, but every Member present could instance a number of cases showing a connexion between ear and eye symptoms and neuralgia, and he had himself had some experience of the bronchial side of pseudo-tuberculous infections.

As to diagnosis it was agreed that transillumination was not of any value unless one side was compared with the other and this was also the case with the X-ray findings. The only certain method was that of exploration. He (the speaker) was glad Sir William insisted that radiologists should refrain from diagnosing sinus trouble, not only because such diagnosis had no foundation, but because it frequently put one into an awkward position with regard to the patient, who had probably brought the skiagrams with him. Sometimes the opinion given was that the sphenoidal sinus was clear but the left frontal sinus contained "matter," whereas

the opposite might actually be the case. Radiologists should describe their findings but should not express conclusions.

With regard to the subjective symptoms, all—specialists, physicians and family doctors—should instruct the public about the appearance of pus and its importance. Patients, especially in the working classes, might be hawking up pus for years without thinking anything of it; the well-to-do called it mucus. If it was grey or white mucus no one was much interested in it, but if the discharge from the nose or mouth was yellow or green advice should be sought, just as it would be if there were such a discharge from the ear.

He (Sir StClair) was showing on the screen four temperature charts to demonstrate how acute a toxæmia could be; these charts also confirmed Sir William Willcox's opinion that, at all events, during the acute stage, there should be little, if any, surgical interference.

The first was the chart of a case dating back two months. The patient had had his septum resected, and everything had proceeded as usual. After being in a nursing home for five days, he had gone home during an influenza epidemic. He had then had a shivering fit, a high temperature, and such a severe headache that he (the speaker) was sent for into the country under the idea that it meant meningitis. But the patient had only an acute sinusitis; he was kept in bed and received inhalations, sprays and douches being avoided. In this way he got well. Last week he was seen again and there was no trace of pus.

He (the speaker) thought the profession in this country should follow that of France in this matter. They operated for chronic conditions only, "à froid," never "à chaud."

The next was the case of a nurse who was under his care with acute pneumococcal sinusitis. In the next bed was a nurse with the same symptoms caused by *Micrococcus catarrhalis*. The symptoms persisted for three weeks, and she had no treatment at all, except steam inhalations. She got well.

The next chart illustrated a somewhat different condition. This patient suffered from acute pan-sinusitis. He had a rigor and such intense headache that during three weeks he never looked at a newspaper. His friends were so convinced that meningitis was supervening that they asked for a consultation, which he (the speaker) readily agreed to, and Dr. Farquhar Buzzard was asked to see the patient. Dr. Buzzard did so, and said there were no meningeal symptoms. He (Sir StClair) lavaged the antra, and pus came from every sinus in the head. This patient underwent the greatest number of antral lavages the speaker had ever given in an acute case, namely, twelve. The recovery of the patient was absolute.

The next slide was a photograph from his text-book, in a case in which the suppuration was not marked, but the nature of the case was undoubted. In the case of this healthy young girl the first symptoms were a rigor and swelling in the neck. These were due to acute double sphenoid suppuration, which led to thrombosis of the cavernous sinus, complete ophthalmoplegia and meningitis, and she died. As soon as she came into hospital he opened her sphenoids; streptococci in pure culture were obtained from the nose and from a gland in the neck, and after death they were obtained from the meninges.

Those charts showed how acute an infection might be, and yet how most of the acute infections subsided under a treatment which was non-surgical.

Dr. JAMES ADAM said: Asthma is based on a toxicosis and, whatever view may be taken as to anaphylaxis or allergy in relation to it, there can be no doubt in the mind of anyone who sees a large number of cases and gives due weight to the clinical histories that a toxic condition often precedes the anaphylactic and renders the patient more liable to the anaphylactic. Some, especially Haseltine and La Forge, in America, hold that there cannot be asthma without nasal infection. This is an extreme view, but it is certain that nasal sinusitis adds to the toxic state, is far oftener present in asthma than is sometimes realized, and that it is useless to treat asthma in such cases without dealing with the sinusitis. It is worth mention that too frequent a cause of nasal sinusitis is the post-operative nasal plug employed by the rhinologist.

Another way in which nasal sinusitis promotes a chronic toxic state is one little recognized, namely, by the causation of bronchiectasis, or rather bronchiolectasis. The nexus is proved: (1) by the case histories, the sinusitis preceding the bronchiolectasis; (2) by the absence of any history of foreign body or of connexion with the operation on tonsils and adenoids; (3) by the fact that in a considerable series of cases the bronchiolectasis is mainly in the right lung, as, in the case of inspirated pus, we should expect it to be from the greatly increased frequency of foreign bodies in the right lung as compared with the left; and (4) by X-ray films taken after injection of lipiodol, a series of such films (exhibited) showing moniliform

outlines as contrasted with the more racemose cavities found in post-pneumonic bronchiectasis, which does not show the same partiality for the right lung.

Mr. HERBERT TILLEY expressed his satisfaction with Sir William Willcox's injunction as to care in forming a judgment about transillumination. He (the speaker) taught his students that if they trusted in transillumination they would frequently go wrong in the diagnosis of maxillary sinus empyema. If an antrum was clear, probably it had not much wrong with it, except in those rare cases of a large cyst which expanded the antrum, or in which the cavity was filled with polypi. Further, a dark antrum did not necessarily mean that active disease was present in it. For these reasons he doubted if it would be wise to advise practitioners to provide themselves with a transillumination lamp, and to base their conclusions on what they found with it, because the diagnosis might be upset by an expert rhinologist who subsequently examined the patient. If this discussion was to be of value it would largely depend on the records of personal experiences. He had himself been less accustomed to find arthritic changes following nasal sinusitis in adults than gastric and pulmonary troubles. In young children he thought arthritic changes were common as a result of acute, subacute, or chronic nasal sinusitis, and he assumed that that could be explained by a vascular condition of bone and the easy absorption of toxins from the sinuses in young children. More commonly the adult complained of gastric symptoms, perhaps because of the amount of pus swallowed, and also of laryngeal or bronchial catarrhs. A common lesion present, when the larynx was affected, was hypertrophy of the inter-arytenoid fold. Caution was advisable when one found a septic focus in the nasal sinuses which seemed to account for some distant symptom, because the obvious inference would be that when that focus was removed the distal symptoms would clear up. But that did not always occur, especially when the sinus infection had been there a long time and more than one focus of infection had been set up. In such a case a colitis, cholecystitis, prostatitis or appendicitis, might have become established.

Dr. PATRICK WATSON-WILLIAMS said that Sir William had stressed the important point that in certain classes of the condition it was the practitioner's duty to think of a focus and investigate, and not wait until the patient complained of symptoms which pointed to a focus of infection. He was glad to hear that Sir William had found that the most frequent cause of the affections under discussion was what was termed a *latent* focal infection, in contradistinction to those which caused local manifestations, as he had himself urged this on many occasions for some years. Staphylococcic infections were often the cause of rheumatoid states, and he had published cases of toxic insanity which were due entirely to that organism alone. It was now recognized that pancreatic disease was sometimes due to a chronic infective condition, and was often associated with chronic cholecystitis. Such patients might have marked glycosuria, and when the source was infective rhinitis this might quickly clear up after an operation on the nasal sinuses.

Dr. W. S. SYME said he had long felt that too much leniency had been shown in dealing with suppuration in accessory sinuses, from the points of view both of diagnosis and treatment. He had taught that the sinuses must be examined when history alone pointed to their implication. Even recurring severe colds in the head justified attention being paid to the sinuses. He agreed that mere transillumination was liable to lead one into error in many cases of antral disease. The only procedure of value, he thought, was to examine the contents of the antral cavity by puncture, or by the method of Dr. Watson-Williams. He (the speaker) certainly believed that there was an association between exophthalmic goitre and nasal sinus disease, and in a recent case of diabetes the trouble only cleared up after the antral cavities had been dealt with.

Sir William had referred to invasion by the *Streptococcus viridans*. It was said that frequently there were no symptoms nor pain, and he (the speaker) was not surprised at that, because often in chronic disease of the tonsil there was no acute attack. Headache, lassitude, and a general feeling of unfitness and wretchedness were common in sinus disease, and therefore it was strange that recognition of the rôle played by the sinuses in this disease had been so tardy. He thought that the worst forms of general toxæmia were those in which there remained behind a focus analogous to a gleet.

Sir JAMES DUNDAS-GRANT said that osteo-arthritis was frequently due to sinus trouble, and clearance of the ethmoidal cells had been seen to convert a nervous wreck into a bright and cheerful individual. He (the speaker) had perhaps not punctured the sinuses as much as he might have done, but he had followed up the pus, and had found an instrument of safety in Cordes' punch forceps, especially for the ethmoidal cells.

With regard to the discrepancy between X-ray examination and transillumination, there was a broad distinction to be made. In the case of the frontal sinus, transillumination was of no value, but in that of the antrum it was very valuable indeed. He (the speaker) would urge general practitioners to use transillumination and learn what it could show, as much as the laryngoscope and the stethoscope, in the interests of the specialist rather than against them.

He was glad to hear what Sir William said about diabetes, as the presence of that disease was sometimes advanced as a reason for not operating. He (the speaker) held, especially in the light of recent knowledge, that it might constitute an extra reason for operating. He remembered particularly two cases of mastoid antrum suppuration in which the patients had glycosuria, and after an expeditious operation the glycosuria disappeared.

With regard to the diagnosis of antral and frontal trouble by rhinoscopy, one should see pus coming from the middle meatus of the nose. But even here there was a source of fallacy, from the fact that the uncinate process of the ethmoid might be so large as to hide the middle turbinal, and pus might seem to be coming from between the turbinal and the septum instead of the outer wall, and from the superior instead of the middle meatus.

Mr. H. BANKS-DAVIS remarked that he understood Sir William Willcox to say that plain water was opaque to X-rays. He (the speaker) was not aware of this, but if so it was an important clinical fact, as that would explain the reason why, on transillumination, an antrum appeared clear when by the radiogram it was reported as opaque.

Sir WILLIAM WILLCOX (in reply) said that Sir StClair Thomson was dealing in his remarks with acute conditions, whereas the speaker was describing chronic states of long duration, which, he was sure Sir StClair would agree, required surgical interference. He agreed with Dr. Adam that sinusitis was a cause of bronchiectasis; he had seen a very interesting case of that with Sir StClair Thomson a few months ago.

Cerebral abscess had long been known as a common complication of bronchiectasis. Mr. Tilley truly said that if one removed the focus seen, it did not always cure the patient. The tubular glands of the colon, if rolled up together, formed a lump as large as the pancreas, and when the colon glands were infected, one should be very cautious in giving a prognosis, for the colon might carry on the bad work. In answer to Dr. Syme, he (the speaker) said he thought exophthalmic goitre generally originated in some toxæmic condition; he had seen several cases which arose from tonsillar sepsis, and he did not doubt that sinusitis might cause it. The danger of operating on diabetic patients should now have passed away, because by methods of dieting one could get the patient sugar-free and bring the blood-sugar to normal, particularly if insulin were pressed into service. If these cases were seen within a few months, they could be cured by removing the cause. In answer to Mr. Banks-Davis's remark as to transillumination and X-rays, he (the speaker) had in mind a clear effusion, which gave a shadow when using X-rays. Water in a tumbler allowed light to get through, but still one could easily see the level of the water in it by X-ray examination.

A Study of the Paths of Infection to the Brain, Meninges and Venous Blood-Sinuses from Neighbouring Peripheral Foci of Inflammation.

PURULENT BASAL LEPTOMENINGITIS FOLLOWING INTRANASAL OPERATION UPON THE ETHMOIDAL AIR-CELLS IN A CASE OF NASAL POLYPI.

(With Microscopic Examination of the Olfactory Nasal Mucous Membrane, Ethmoidal and Sphenoidal Air-Sinuses and the Meninges).

By A. LOGAN TURNER, M.D., F.R.C.S.Ed., and F. ESMOND REYNOLDS, M.B.

[The paper will be published *in extenso* in the *Journal of Laryngology and Otology*, 1926.]

[ABSTRACT.]

PATIENT, a male, aged 33, was admitted to the Ear and Throat Department, Royal Infirmary, Edinburgh, under the care of Dr. G. Ewart Martin. He was suffering from chronic nasal obstruction and postnasal discharge due to the presence of bilateral mucous polypi.

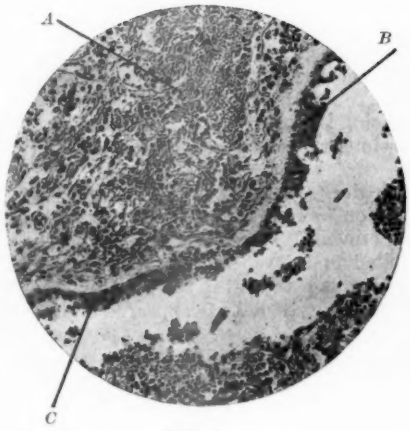


FIG. 1.

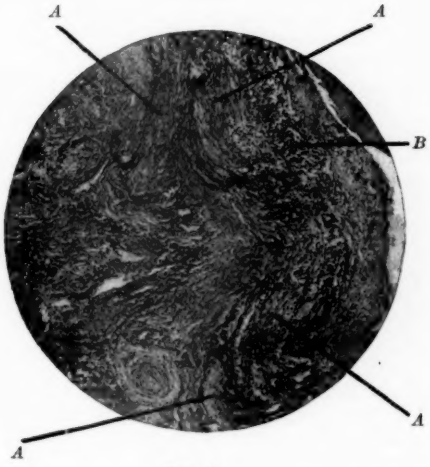


FIG. 2.

FIG. 1.—Right olfactory mucous membrane (*A*), showing an area of columnar (*B*), and of flattened (*C*) lining epithelium; the sub-epithelial tissue shows dilated blood-vessels and infiltration by mononucleated and a few polymorphonuclear cells.

FIG. 2.—A right olfactory nerve (*A*) in the mucosa of the nasal septum; the perineural lymphatic sheath (*B*) contains numerous polymorphonuclear leucocytes.

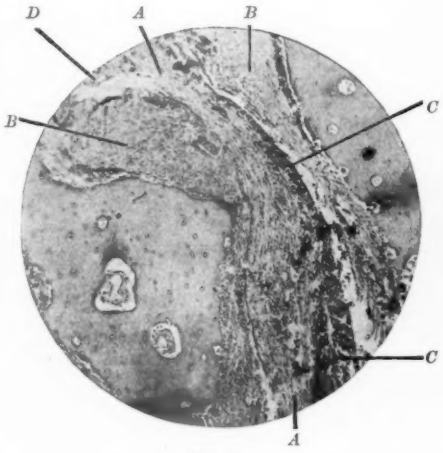


FIG. 3.

FIG. 4.

FIG. 3.—The same nerve as in fig. 2 (*A*) passing through the cribriform opening and dura mater (*B*). The pus in the perineural lymphatic sheath (*C*) is continuous with that in the pia-arachnoid meshes (*D*).

FIG. 4.—Tract of a left olfactory nerve in the dura mater (*A*). The nerve fibres have disappeared and the canal is full of pus.

On August 22 the polypi were removed and the ethmoidal cells exenterated on both sides. On the afternoon of the 23rd, the patient complained of severe headache and his temperature rose to 103·8° F. On the 24th, the cerebro-spinal fluid was turbid; a pure growth of the *Pneumococcus* was obtained from the fluid. The patient became unconscious and died on the evening of the fifth day after operation.

Autopsy revealed a diffuse purulent basal leptomeningitis; the *Pneumococcus* was obtained from the pus in the meninges.

After decalcification of a block of bone comprising the olfactory areas of the nose, cribriform plates, ethmoidal and sphenoidal air-sinuses, serial sections were made in the coronal plane.

The microscope revealed the following pathological conditions:—

In the olfactory nasal mucosa, an acute infection was superimposed on a chronic inflammation; in the right nasal cavity the perineural lymphatic spaces of the olfactory nerves in the septal mucosa were dilated and invaded by numerous polymorphonuclear leucocytes, and the pus was continuous with that in the pia-arachnoid spaces. In the left nasal cavity the olfactory nerve fibres had disappeared and the canals thus formed were full of pus.

In the ethmoidal air-cells on both sides, the superficial portion of the mucous membrane showed a chronic infective process with early acute changes.

In both sphenoidal sinuses, the mucous membrane showed recent acute inflammatory changes.

The cavernous blood-sinuses contained non-infected post-mortem blood-clot.

The pia-arachnoid membranes were infiltrated by pus.

During the operation, injury to the olfactory mucous membrane had opened the lymph sheaths of the olfactory nerves. In the nasal mucous membrane an acute inflammation was superimposed on a chronic process, and the infection had passed up the olfactory neural tracts and spread to the pia-arachnoid spaces round the intradural portions of the olfactory nerves, thus causing a leptomeningitis.

Discussion.—Mr. J. A. GIBB said that he had been in the habit of removing half or the whole of the middle turbinal, and then proceeding to the ethmoid cells, and he wondered whether any other route would be safer. He had operated on a large number of these cases and so far had experienced no cerebral complications.

Dr. PATRICK WATSON-WILLIAMS said that many years ago he had operated on a case of chronic sinusitis with extensive polypoid degeneration and the patient had died of meningitis. He was certain that he did not injure the cribriform plate and was driven to conclude that the infection had travelled by way of the venules. (There was no post-mortem examination.) It seemed to show that, in cases with infective disease involving the upper ethmoid region, it was better to fail in producing a complete cure than to run the risk of approaching too near to the roof of the nasal passages, not for fear of direct injury to the cribriform plate but owing to the risk of the opened lymph-vascular channels conveying infection to the sub-arachnoid space.

Mr. HERBERT TILLEY said that questions had been raised as to how one could incur the minimum risk in operating on the ethmoidal region, as surgical intervention was being carried out on it with increasing frequency. It was recognized that if nasal polypi were to be cured, the inflamed bone from which they grew must be removed, and this brought one into the neighbourhood of very important structures. The fundamental position to be taken up by the surgeon was, that in order to avoid risk he *must* keep on the outer side of the level of attachment of the middle turbinal. So far he had not had a fatality in ethmoidal operations, and he exhibited two instruments which, in his hands, seemed to minimize risk and yet enabled one to grasp the diseased tissue and remove it.

Sir JAMES DUNDAS-GRANT said it was important to keep in mind the fact that there were cases of meningitis secondary to disease in these sinuses, apart from a preceding operation. One might be on the verge of such meningitis when starting an operation, and the surgeon was apt to blame himself for results which might have been due to pre-existing factors beyond his scope. When severe headaches and much disturbance were present,

it might be advisable to perform an exploratory lumbar puncture before operating. In Dr. Turner's case the fluid might have been turbid before the operation. He directed attention again to Cordes' forceps which he had shown earlier in the afternoon; they reduced the risk of tearing to quite the minimum, and he considered it of great importance that the instruments employed should cut and not tear.

Dr. JAMES ADAM said that Dr. Turner's communication helped to explain a death he (the speaker) had had in the case of a lady from whom he removed polypi. There was a somewhat similar history. He did not know what the organism was, but it was noteworthy that in Dr. Turner's case the infection was pneumococcal.

The author's suggestion that rupture of the cribriform plate was not necessarily fatal was confirmed by a case in which he (Dr. Adam) had experienced this *contretemps* during an operation on the ethmoid and in which there was escape of cerebro-spinal fluid. He painted with iodine, did not pack and did not allow the patient to lie down for three days. The patient recovered.

Sir STCLAIR THOMSON said it was recognized by rhinologists that there were three lines of infection through the nose, one of which Dr. Turner had dealt with. The first was from traumatic fracture of the cribriform plate; the second was a vascular infection, and the third—which had just been so admirably dealt with—along the sheath of the olfactory nerves. It should still be realized that this infection was not so uncommon as Dr. Turner seemed to regard it, because such cases were not often published when they occurred. He had had two, but had not had any since those early days of twenty-five years ago. Mosher pointed out that the particular danger zone was a posterior ethmoid cell, far back, whence one could easily enter the cerebral cavity. As Dr. Turner pointed out, the great thing was to keep outside the middle turbinal; and it was better to enter the orbit than the cerebral cavity. This area was on a level with the inner canthus of the orbit, and by touch, and by watching where the patient's head was, one could keep below that level and outside the attachment of the middle turbinal.

Dr. W. H. KELSON (President) asked what were Dr. Turner's views in regard to packing the nose. For many years he himself had taught, and believed, that packing should be used as little as possible there, and he was glad to hear that Dr. Adam held similar views. In his earlier cases there was occasionally a rise of temperature, and that occurred much more frequently when the nose was packed. He did not now pack if it could be avoided.

Dr. LOGAN TURNER (in reply) said that the olfactory branches were not distributed over the middle turbinal, though he had seen the statement made in Gray's "Anatomy" that they did so. If, in operating on the ethmoid cells, one removed the middle turbinal, and then worked laterally, the olfactory branches should not as a rule be torn. The nasal cavities in the case just demonstrated were not packed after operation. He (the speaker) said that there was no evidence of meningitis before the operation. He was interested in the fact that the patient had a chronic inflammatory condition of the olfactory mucosa. He and Dr. Reynolds had formed the opinion that the perineural sheaths had been torn, that the *Pneumococcus* had obtained entrance, and that the inflammation had spread rapidly up the sheath.

The Rôle of the Lymphatics in Laryngeal Disease; and the Rôle of the Larynx in Lymphatic Disease.

By JOBSON HORNE, M.D.

DR. JOBSON HORNE said that it was more that twenty-five years ago that the lymphatic supply of the larynx appeared to him to be an open field for research. In 1901 and 1903 he published in the *Journal of Laryngology*[1] some of those researches.

The time had come for co-ordinating results, and the following is a summary of clinical and pathological deductions from his own researches.

[1] "The Larynx, a Site of Infection in Certain Diseases of the Lymphatic Glands known as Lymphadenoma, Lymphosarcoma, Tuberculous Lymphadenitis, &c.; and a Note on Primary Tuberculosis of the Organ," *Journ. Laryng., Rhinol. and Otol.*, December, 1901, p. 684.

"The Upper Respiratory Tract as a Source of Systemic Infection," *Journ. Laryng., Rhinol. and Otol.*, November, 1903, p. 572. Being Introductory Remarks to a Discussion in the Section of Laryngology and Otology of the British Medical Association Annual Meeting at Swansea, July, 1903.

Dealing first with the rôle of the lymphatics in laryngeal disease, Dr. Jobson Horne said that it was remarkable there were very few diseases of the larynx in which the adjacent and corresponding cervical glands became involved. The factor determining the involvement of the adjacent lymphatic glands was whether the disease in the larynx was primary or secondary. If primary, the glands became involved; if secondary, the glands were not affected. The outstanding and typical example of the former was malignant disease of the larynx. In carcinoma of the larynx an adjacent cervical gland sooner or later became palpable. That "sooner" or "later" was governed by the disease being extrinsic or intrinsic; and if intrinsic, by the disease originating in the part covered with columnar epithelium or in the part covered with squamous epithelium. Whereas in syphilis and tuberculosis—taken as types of secondary disease—no matter how destructive the disease in the larynx the adjacent glands were not involved.

Tuberculosis of the larynx was *always* secondary to chronic phthisis, as distinct from miliary tuberculosis of the lung. In pure miliary tuberculosis of the lung, that is to say without any breaking down of the lung, infection of the larynx did not occur. In tuberculosis of the larynx secondary infection of the cervical glands *never* occurred. That "always" and that "never" sounded dogmatic, but the dogmatism was justified by the results of clinical and pathological research.

A case of tuberculosis in which the cervical glands became infected by a recrudescence of the disease in the larynx, some years after the disease in the lungs and the larynx had become arrested, was cited as an exception which proved the rule he had laid down.

It was noteworthy that a very small percentage of the subjects of tuberculous necks suffered from chronic phthisis. Therefore such subjects escaped laryngeal tuberculosis.

Passing to the rôle of the larynx in lymphatic disease, Dr. Jobson Horne demonstrated a fold in the larynx passing downwards and forwards between the cartilages of Santorini and Wrisberg, to end near the posterior vocal process. That he described as the vulnerable spot in systemic infection through the larynx. (*Vide* diagram *Journ. Laryng., Rhinol. and Otol.*, November, 1903, p. 574.)

Larynges[1] showing ulceration, or breach of surface, or old scarring at that spot and removed post-mortem from cases of Hodgkin's disease, and one from a case of mediastinal sarcoma, were demonstrated. The results of those investigations led Dr. Horne to the conclusion that in not a few cases Hodgkin's disease was tuberculosis, and that some cases of sarcoma should be placed amongst the granulomata.

Discussion.—Sir JAMES DUNDAS GRANT agreed that the vulnerable spot spoken of by Dr. Jobson Horne was very vital, and that it was often missed in examinations. He asked that pathologists should, at post-mortem examinations, open larynges from the front, as there would be presented the picture most usually seen on examination during life.

Dr. W. H. KELSON (President) said he was one of those who were present when Dr. Jobson Horne read his paper twenty-six years ago at Hanover Square before the old Laryngological Society. At that time Dr. Horne showed that in the investigation of this subject a wide field of research lay open, and he (the speaker) had wondered why Dr. Horne had not pursued further research. But it now seemed clear that he had done so, and he hoped Dr. Horne would continue these important investigations.

Dr. JOBSON HORNE (in reply) said that many years ago, realizing that a very large majority of the lesions in laryngeal disease occurred in the posterior half of the larynx, he had always endeavoured to obtain post-mortem larynges before they had been opened. It was by opening them with an incision through the anterior commissure he had been able to observe the lesions he had recorded. Unfortunately it was found to be more convenient to open a larynx by an incision through the posterior commissure and to demonstrate the larynx by placing the thumbs upon the parts where a lesion might be present.

[1] *Journ. Laryng., Rhinol. and Otol.*, December, 1901, p. 684.

[*June* 4, 1926.

CLINICAL MEETING.

FURTHER REPORT OF CASE PREVIOUSLY SHOWN.[1]

Perforation of the Palate.

By H. BELL TAWSE, F.R.C.S.

MRS. J., aged 43.

November 21 *to January* 30.—Inunction of oleate of mercury began November 21, continued, and gradually increased in strength till every available area resented further treatment, which ceased on January 30. Alkaline nasal douche twice daily. Nose and naso-pharynx cleansed of crusts by me three times a week. Emulsion ol. morrhuæ ʒss. t.d.s. The palate looks healthier but there is no diminution in the size of the perforation and the edges are still ragged and show no sign of healing. Less crusting in nose and naso-pharynx. Health improving.

January 31.—Ultra-violet rays to chest and abdomen three times a week. Douche and cleansing of nose continued as before, also emulsio ol. morrhuæ.

February 21.—Perforation much smaller, ragged edges disappearing. Nose and naso-pharynx healthier.

March 1.—Wassermann test negative. Patient states that she never felt so well before. Edges of perforation firm and smooth. Nose and naso-pharynx painted once a week with 20 per cent. argyrol.

April 10.—Edges of perforation completely healed. No crusting of nose or naso-pharynx. Nasal douche, ultra-violet rays and ol. morrhuæ still continued. Wassermann test negative.

REMARKS.

Mercurial inunction did not do the slightest good, and any slight improvement during the course might just as easily be credited to the ol. morrhuæ. The first well-marked sign of progress appeared within ten days of the first application of ultra-violet rays. The right half of the soft palate is thinner than the left. On the upper surface of the left soft palate can be seen a greyish pink mass the size of a pea. It is firm to the touch and has a smooth surface. Patient, who is unaware of its presence, is in perfect health and is having a new denture fitted. Examination of cerebro-spinal fluid was not done as patient declined to allow lumbar puncture.

Microscopic section of edge of perforation shown.

Discussion.—Mr. H. TILLEY congratulated the exhibitor on the good result obtained in this case. The treatment gave a lead in cases in which the tests for syphilis and tubercle were negative. But he doubted whether in this patient the lesion was one of simple sepsis because its appearances were so unusual. In spite of the negative evidence of tubercle, he thought it was probably of that nature, and one knew how effective ultra-violet rays might be in such conditions.

Dr. W. H. KELSON (President) said that this was the mysterious kind of case with indefinite ætiology which one saw from time to time, and which some regarded as tuberculous, others as syphilitic. Two years ago he (the speaker) had had such a case at Golden Square, in which ulceration had persisted for a long time, and then suddenly healing occurred without any evident reason. A year later, however, that patient had had definite malignant disease in the same site, and he (the President) had often wondered whether this condition might be a precursor of malignant disease. He asked that the present case might be reported on again after an interval.

Mr. BELL TAWSE (in reply) said that on the suggestion of Sir James Dundas-Grant the section would be referred to the Morbid Growths Committee for a report.

[1] See *Proceedings*, 1925-26, xix (Sect. Laryng.), p. 23.

NEW CASES AND SPECIMENS.

Case of Ozæna apparently cured by Submucous Injection of Paraffin.

By Sir JAMES DUNDAS-GRANT, K.B.E., M.D.

PATIENT, a female, now aged 65, first seen in January, 1910, on account of dullness of hearing (whisper reduced on right side to 18 inches and on left to 3 inches) of 10 to 20 years' duration.

The nose, especially on the left side, was found to be full of greenish crusts of extreme fœtor, of which the patient was not conscious.

She was treated with peroxide of hydrogen, glycerine, glucose and various other remedies with only slight momentary benefit, but it was in 1916 that a very remarkable improvement first took place immediately following the injection of a small quantity of cold paraffin under the septal mucous membrane. The amount injected was not sufficient to reduce the patency to any material extent and its action must have been purely stimulating. From that time onwards the smell and crusting rapidly diminished and for years she has employed no treatment except a douche of plain boiled water each morning.

Swelling in Larynx: Case for Diagnosis.

By D. R. PATERSON, M.D.

MALE, aged 25, a healthy collier, two and a half years' hoarseness coming on "after attack of tonsillitis." Externally, fullness over right thyroid ala; laryngoscopic examination shows right side of larynx and adjoining pyriform sinus occupied by a smooth red swelling which prevents view of right cord. Slight stridor, no dysphagia; Wassermann, negative; sputum, negative. Has been under observation for ten months, during which time swelling has increased somewhat and extended to arytenoid region. Six months ago piece removed for examination and reported to be "granulation tissue mostly." Iodide and mercury in full doses have been given and four months ago radium (75 mgm.) was applied externally without result.

Discussion.—Mr. NORMAN PATTERSON said that some of the appearances in this case suggested chondroma, and he (the speaker) thought that the inflammation might be due to the application of radium. Did Dr. Paterson carry out digital examination?

Mr. H. TILLEY suggested that this was a perichondritic inflammation and probably of the thyroid cartilage. The chronicity "put malignant disease out of court," and if it were enchondroma one would not expect to see the mucous membrane on that side quite so red. The general features were very similar to those which Professor Hajek published in a monograph many years ago; in one of his cases there was a very definite swelling of the arytenoid and the homo-lateral laryngeal structures inside the thyroid cartilage. There was also some swelling outside the thyroid. Probably in the case seen to-day an original traumatic lesion had become complicated by a mild septic infection.

Mr. H. BELL TAWSE asked whether the stridor was increasing. If not, he advised making an excision along the thyroid cartilage and through the perichondrium, where there might be a small abscess. He (the speaker) had shown two years ago a boy, aged 10, in whose larynx the formation of an abscess had been caused by his mother putting her finger down his throat to remove a mutton bone which was choking him; necrosis of the cartilage was followed by cicatricial contraction and the voice was subsequently lost.

Sir JAMES DUNDAS-GRANT agreed with the opinion expressed, and advised tracheotomy followed by exploratory thyrotomy, as a piece of necrosed cartilage might be found.

Dr. W. H. KELSON (President) said that digital examination was most important here; possibly it might be a fibro-lipoma. Several of these cases had been shown at the Section and usually the correct diagnosis was not made until revealed by operation. Had anything been detected in the neck before radium was applied?

Mr. G. WILKINSON said that the case reminded him of one which he had shown at a meeting of the Section some years ago[1], that of a man who, during a choking attack, had introduced a finger into his throat and had thus produced an abrasion of the larynx, followed by an extensive inflammatory induration, which remained for at least two years. He thought the present case was one of chronic inflammatory induration of the larynx, due to infection, probably arising from the tonsillitis.

Mr. J. F. O'MALLEY asked whether there was any suggestion of recent typhoid in this case, as sometimes that disease would leave perichondritis, with the formation of granulation tissue and an abscess. Three years ago he had had a patient with similar symptoms. This patient had some septic teeth, and they were removed; also there were one or two septic foci on the face and in the mouth. Finger examination showed that the mass was very smooth and elastic. A considerable quantity of pus was obtained from it, and the patient then got well.

Dr. D. R. PATERSON (in reply) said it reminded him of the obscure cases in which the diagnosis lay with syphilis, carcinoma, and ordinary perichondritis. He did not feel it with his finger, but when the patient was under an anæsthetic he was able, with a probe, to test it, and the impression was not that produced by cartilage. It felt firm, and the infiltration at that time was limited to the upper part of the right side of the larynx, above the vocal cord, and it was from that part that he took a piece for examination. The notes said it came on after an attack of "tonsillitis"; probably there was an infective condition. He had hoped to be told what was the best course to pursue; whether he was justified in splitting open the larynx, or approaching it from outside, through the thyroid cartilage. The fact that the mucosa was red from the first was against the idea of enchondroma or lipoma, and favoured the view that it was a chronic inflammatory condition. The sore on the skin of the neck was due to radium. He promised to report the case later.

Chronic Hyperplasia of Upper Jaw.

By HAROLD BARWELL, M.B., F.R.C.S.

BOY, aged 11. Swelling of right upper jaw noticed December, 1925. First seen March 12, 1926. Hard, rounded swelling of anterior surface of superior maxilla, infra-orbital margin slightly raised, and perhaps slight flattening of palate on right side; no nasal obstruction; naso-pharynx normal. Quite dark on trans-illumination, and skiagram shows diffuse bony thickening. Exploratory operation in canine fossa March 24; swelling consisted of dark red, rather soft bone; no antral cavity found.

PATHOLOGICAL REPORT BY DR. ROBERT DONALDSON.

Histologically the sections consist of a fairly dense irregular network of bony trabeculæ, the interstices of which are occupied by vascular fibro-cellular tissues. Osteoblasts are present in moderate numbers, together with a few osteoclasts. A few lymphocytes can be seen scattered here and there in an irregular manner but there are practically no polymorph leucocytes except in relation to small collections of extravasated blood on the edge of the sections. There is no inflammatory reaction such as would indicate organismal infection, and there is no suggestion whatever of malignancy.

The histological appearances point to that somewhat rare condition described by Westmacott [1] under the name of "chronic hyperplasia of the posterior maxilla." The histological findings in two other cases of the disease reported by Douglas Guthrie are described briefly by J. Struthers and J. Dawson in an important paper [2] on generalized osteitis fibrosa. The histological features of the tissue removed from the case now presented correspond with those found in Westmacott's and Guthrie's cases.

[1] *Proceedings*, 1914, vii (Sect. Laryng.), p. 83.

The enlargement is a unilateral one and the antrum is more or less filled up with vascular fibro-cellular tissue contained in an irregular network of reticular bone. No inflammatory reaction, indicative of sepsis, was found either in Westmacott's or Guthrie's cases. Westmacott accordingly interpreted the histological findings as a reversion on the part of the bone to an embryonic type. Dawson, however, has gone further and has shown fairly conclusively that the initial lesion, in practically all the bone dystrophies, is one affecting the bone corpuscle. In generalized and in localized osteitis fibrosa there is a possibility that the interference with the vital functioning of the bone corpuscles is due either to the action of some unknown toxi-infective substance carried by the blood-stream, or to circulatory changes, while, in some cases at least, there may be some inherent weakness on the part of the mesenchymatous tissue. The histological findings in cases of chronic hyperplasia of the superior maxilla bear a strong resemblance to those found in the affected bones in fibrous osteitis—a localized bone lesion related in some way to a definite, known, septic focus in the tissues in the near vicinity. Dawson rightly points out that, in the condition of the jaw under discussion, there is a possibility of irritation arising from a septic condition of the mucosa of the antrum. The existence of such a septic condition, however, has not so far been proved, but it is interesting to note that in otosclerosis—a somewhat similar localized bone lesion—there is the same proximity to a possibly infected mucous membrane. Dawson considers that the lesion of the superior maxilla may represent a transition between fibrous osteitis on the one hand, where there is a known septic focus in the immediate neighbourhood, and an osseous dystrophy such as localized osteitis fibrosa on the other, where there is no immediate focus of sepsis nor any mucous membrane which might become the seat of organismal infection. This condition of the jaw can hardly be regarded as directly due to an organismal factor, but there may, nevertheless, be a relationship, though not a genetic one, between some toxi-infective agent and the morbid condition of the bone.

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[1] WESTMACOTT, F. H. "Chronic Hyperplasia of the Superior Maxilla," *Inter. Med. Cong.*, 1913. Section xv, p. 243. [2] STRUTHERS, J., and DAWSON, J., *Journ. Laryng.*, November, 1923, p. 575, [3] GUTHRIE, D., "Generalised Osteoitis Fibrosa," *Edin. Med. Journ.* 1923, xxx, No. 10, p. 489.

Discussion.—Dr. W. H. KELSON (President) said that three years ago Professor Knaggs had published in the *British Journal of Surgery*[1] a full and well-illustrated account of cases of this kind. He held, definitely, the view that they were cases of osteitis fibrosa. Two years ago, at a meeting of the British Medical Association at Bradford, he (the speaker) had read a paper on the subject[2] supporting this view.

Dr. DOUGLAS GUTHRIE said that the pathology of these bony enlargements of the upper jaw had been the subject of much controversy. It was probably better to regard this case as "chronic hyperplasia" rather than as "osteitis fibrosa." The disease was not very rare, but museum specimens were rare because the condition was now correctly diagnosed. Formerly it had been regarded as a condition which demanded excision of the upper jaw, but we did not now resort to such drastic treatment. In fact, in many cases, no treatment was required as the enlargement was not progressive. During the past five years he (Dr. Guthrie) had had under observation a boy, now aged nine, who had suffered from this disease since birth. The enlargement had undergone no increase since he (the speaker) had first seen the case.

Mr. H. BELL TAWSE said that he had had a case, in a girl aged 10, the pathological report of which had been very similar to that on this case. He (the speaker) had chiselled away a great deal of cancellous bone and had then stitched the wound up to the submucous membrane. Since the operation there had been no further enlargement.

Mr. LESLIE POWELL said that he had recently seen two cases, both in women, one aged 45 the other aged 55. In the first there were three bony enlargements; one on the malar part, one close to the nose, the third on the alveolus, and they were very disfiguring. They had been removed some years previously, but had formed again and had grown larger than before. After removing them, he (the speaker) applied diathermy to the base. There had been no recurrence. The enlargements in the other case, also, had not returned after removal under diathermy.

[1] *Brit. Journ. Surg.*, 1922-23, x, pp. 487-500.

[2] *Brit. Med. Journ.*, 1924, ii, p 1197.

Mr. A. D. SHARP said that a woman, aged 35, had been referred to him by her dentist, because of a large swelling in the alveolus. The swelling had extended to the mid-line of the palate, and largely involved the right alveolus. On X-ray examination the antrum was seen to be filled up, and the ethmoidal cells involved; and three-fourths of the frontal sinus were involved. There was no specific history, and the extension had been a gradual one, lasting over many years.

Mr. J. F. O'MALLEY said that two years ago he had shown a similar case which had been referred from the Eye Department because of proptosis and a fistula between the eye and the root of the nose. X-rays cast several dense shadows in the right ethmoid region and part of the right frontal sinus, and there were similar shadows on the left, but no symptoms. He removed two large-sized dense masses of bone; one from the region of the sinus externally, the other from the ethmoid through the nose. The result, so far, had been good, but he expected that the left frontal sinus would become involved.

Patient who underwent Total Laryngectomy Two Years ago and has since Acquired a Useful Voice.

By DOUGLAS GUTHRIE, M.D.

J. P., A HEALTHY man, aged 35, was "gassed" in 1918, and has suffered from occasional hoarseness ever since. For two years before admission to hospital in June, 1924, the hoarseness had been continuous, and for seven months he had suffered from shortness of breath, worse on lying down. Laryngoscopy showed a large, smooth swelling of left ventricular band and left arytenoid region. The left vocal cord was not visible, but the right cord, partly seen, appeared healthy. Wassermann reaction negative; examination of chest and sputum negative. While under observation, the dyspnœa became worse and tracheotomy was performed on July 7, 1924. On the suggestion of Sir James Dundas-Grant, who kindly saw the patient, a portion of tissue was removed through the tracheotomy wound, and this proved to be epithelioma.

On July 21, 1924, total laryngectomy was performed, and the left lobe of the thyroid gland, being involved, was also removed. The patient was fed by a nasal tube for two weeks, and healing was satisfactory. He is now engaged in poultry farming in Devonshire, and when last seen by the exhibitor in September, 1925, had acquired a remarkably good pharyngeal voice.

Discussion.—Dr. D. R. PATERSON asked how soon after the operation the training began, and how soon voice was produced. In 50 per cent. of such cases speaking was carried out after swallowing air, and the mechanism of voice-production was somewhat analogous to that in the bagpipe. In a case closely observed it was found that the sound was produced from folds at the lower part of the pharynx, at the mouth of the gullet, from side to side. Those who could not swallow air were given an alkali, followed by citric acid, and with the gas so evolved voice could be produced. Some of these people were old, and took badly to training, and in their case dilatation of the stomach with air must be done with caution. On the other hand some patients could not eructate. The present patient (Dr. Guthrie said) produced a good voice when he had indigestion. He had learned to depend on contraction of the abdominal muscles.

Dr. W. S. SYME said he had shown to the Scottish Society of Otology and Laryngology a patient whose larynx he removed eight years ago, and he had developed such a good voice that he could make himself heard in a large hall. He did not think these patients swallowed air into the stomach, but in his own patient's case it might be collected in the pharynx or the œsophagus. In the case of a woman whose larynx he had removed, she could not produce anything like a decent voice. Much depended on the person's temperament.

Mr. PHILIP FRANKLIN said that he had heard a patient in New York audibly address an audience, although complete extirpation of the larynx had been performed by Dr. Lee Hurd a year previously. The voice was husky, much like that of a person suffering from chronic

laryngitis. The patient described how he was first led to attempt to produce an audible voice. He noticed that after a meal of pork and beans the gaseous eructation from the stomach produced a sound. He was able to reproduce this eructation by swallowing air and letting it out at will. He controlled the exit of air from the gullet by fixing the lungs after a deep inspiration through the tracheal opening. The opinion of the meeting had been that the simulated voice sounds were produced either at the pharyngeal opening of the gullet or by the pillars of the fauces.

Mr. A. G. SHARP said he remembered a case in a ventriloquist, who produced a remarkably good voice. He might have acquired, during the practice of his art, a good control over his trunk muscles.

Mr. G. WILKINSON said that a necessary condition for the production of this kind of voice was that the patient should have learnt to relax both the pharyngeal and diaphragmatic sphincter, so that he could draw air into the stomach, and then force it out by contraction of the upper abdominal muscles. He did not think the present patient swallowed air at all. The necessary reservoir of air could not be in the œsophagus itself, because, the trachea being open, he was unable to cause any degree of pressure in the thorax to expel the air. The man's speech was really a loud whisper, produced by forcing air through the upper resonating cavities. There was no vibration such as gave the ground tone to ordinary speech.

Dr. W. H. KELSON (President) said these cases were not only interesting but also reassuring. The senior Members would remember the time when a man who had had his larynx removed was congratulated on being alive. Later came a time when, after removal of the larynx, a more or less clumsy speaking apparatus was fitted, which was considered to be a great success. Nowadays the man who had undergone the operation wore nothing except, perhaps, a tracheotomy tube, yet could speak intelligibly. This represented a very great advance.

Dr. DOUGLAS GUTHRIE (in reply) said that his patient was a smoker; he resumed smoking early in his convalescence. The air was not consciously swallowed nor was the patient aware that that contracted his abdominal muscles. He seemed to produce his voice by dilating his œsophagus, and certainly the abdominal muscles were not tightened by conscious effort. He recovered a little use of his voice within a month of the operation, and when he left, two months after operation, he was able to make himself intelligible to the nurses. Of course there was still room for improvement. He had never had any lessons in voice-production, but had evolved his own method. In answer to Dr. Paterson's remarks about bagpipes, the man himself said that only a Scotsman could have recovered, and recovered with such a voice!

Mr. H. BELL TAWSE, F.R.C.S., showed Microscopical Sections of Nasal Polypi removed from a child, aged six months, on January 21, 1926.

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Section of Medicine.

President—Dr. HUGH THURSFIELD.

DISCUSSION ON THE CLINICAL ASPECTS, TREATMENT AND PROGNOSIS OF NEPHRITIS.

Dr. HUGH MACLEAN.

[SUMMARY.]

IN discussing the clinical aspects, treatment and prognosis of renal disease it might be well to take these three headings in turn.

The *clinical aspects* of nephritis can best be understood when viewed from the physiological aspect of renal function. The chief functions of the kidney with which we are concerned clinically are as follows: (1) Excretion of water. (2) Excretion of salts. (3) Excretion of waste products of metabolism. (4) The maintenance of the normal reaction of the blood.

In nephritis there is always some interference with one or other of these functions and it is on the particular nature of the interference that the clinical manifestations depend. It is obvious that a diminution in the excretion of water will result in œdema. When salt is not properly eliminated we get exactly the same result—a great retention of fluid in the body. This effect of retained salt in producing œdema depends on the fact that a high concentration of salt in the body is exceedingly detrimental to the tissue cells. Consequently, Nature has provided against the possibility of such an event, with the result that when the kidneys are unable to excrete salt, the body retains sufficient water to dilute the retained salt to the optimum concentration. In this way, when excess of salt cannot be eliminated, œdema always results.

The excretion of nitrogenous waste products is a most important renal function, but it is very necessary to realize that this particular function may be very much diminished and yet the excretion of salt and water be but little affected. Disturbances in the mechanism maintaining the normal reaction of the blood are usually associated with the more severe kidney lesions.

THE DIFFERENT VARIETIES OF RENAL DISEASES.

A good deal of confusion exists at the present time with regard to the different varieties of renal diseases, but from the clinical point of view there are only three varieties, acute, subacute and chronic nephritis. In acute nephritis the whole of the active kidney substance is thrown out of action and all the renal functions are temporarily in abeyance. This results in such clinical symptoms as diminished excretion of urine, marked œdema, retention of nitrogenous waste products and disturbances in the mechanism maintaining the reaction of the body fluids.

In *subacute hydræmic nephritis* only two of the kidney functions are involved. The patient is unable to pass salt and water but there is no interference with the other functions mentioned. Consequently, this variety of disease is characterized by one marked symptom, namely, very intense œdema. Since toxic material and waste products are eliminated as usual there are no cardio-vascular disturbances, no eye changes and no uræmic manifestations. In fact, the only important symptom is the retention of fluid, and since the disease is characterized by the presence of excessive

fluid in the system it is best referred to as hydræmic nephritis. This is the condition discussed in the text-books under the heading of chronic parenchymatous nephritis. It never becomes chronic, however, but is a subacute condition which either clears up, or almost literally drowns the patient, or passes into chronic renal disease of the type to be discussed immediately. The urine in hydræmic nephritis always contains an excessive amount of protein.

In *chronic nephritis* the histology of the kidney may vary considerably, but the system hitherto adopted of classifying chronic renal diseases according to the structural defects in the kidneys can only lead to unnecessary confusion. In every case of chronic disease, no matter what the ætiology may be, the clinical results are the same. Chronic renal disease is characterized by a difficulty on the part of the kidney to excrete the waste products of metabolism. Unlike what obtains in hydræmic nephritis there is usually little or no defect in the excretion of water or salt. Consequently, œdema is rare in typical cases of chronic disease, and when present it frequently arises from cardio-vascular disturbances. Since the chief difficulty in this variety of disease is the excretion of nitrogenous end-products, it is best referred to as *azotæmic nephritis*.

It is most important to remember that hydræmic nephritis which does not clear up always tends to pass into a condition which is exactly the same as that found in azotæmic nephritis. The œdema tends to disappear, water and salt are excreted fairly well, but nitrogenous waste products are retained. It is this fact that has given rise to so much confusion in the text-book description of chronic parenchymatous nephritis. The exact symptoms found in hydræmic nephritis depend on the stage of the disease. There may be only the one symptom of hydræmia, or some hydræmia may persist and all the symptoms of chronic renal disease may be present as well. At this stage the condition has really passed from *hydræmic* to *azotæmic* nephritis and it should be described as such. Consideration of these points will help very materially in appreciating the various clinical aspects of renal disease.

The *treatment of nephritis* can be dealt with very shortly. Nearly all the remedies used in this disease are valueless. The use of diuretics is based on a misconception of the pathological processes present. Generally speaking, diuretics never do any good in renal disease and they should not be used. While it is inadvisable to give much protein food in severe cases of the acute disease, it is certain that the usual custom of cutting down the protein, and frequently, indeed, the whole contents of the diet, to a minimum is wrong treatment. By the help of modern tests the condition of the excretory functions of the kidney can be quite definitely ascertained, and where the excretion of nitrogenous waste is good there is no reason why protein should be greatly restricted. It is not suggested that excessive amounts of protein should be used in ordinary cases, but very frequently the patient who is afflicted with albuminuria and mild chronic renal disease suffers much more from treatment than from his ailment. The diet should be sufficient to maintain normal weight. The old idea that red meat is more injurious than white is a figment of the imagination.

Strange as it may seem, there is no real evidence that protein is in any way injurious to the kidneys. In the course of some experiments carried out in my laboratory it was found that marked renal changes could be brought about when rabbits were fed on very high protein diet, but that on the addition of a very small amount of green food to the diet these changes very soon disappeared, even when the high protein intake was continued as before.

The use of water to flush out the kidneys in renal disease is also based on an unsubstantial foundation. It is impossible to flush out the diseased kidney, and the introduction of large amounts of fluid only tends to increase the œdema and to embarrass the heart.

The special high protein diet recommended by Epstein is frequently used with success in hydræmic nephritis, but urea given by mouth is equally efficacious in

getting rid of the excess of fluid, and probably possesses advantages over protein. Decapsulation of the kidneys does not appear to be of any value except perhaps in a very few special cases.

PROGNOSIS.

Here consideration of the general condition of the patient is often helpful, but modern renal efficiency tests afford the best means by which a rational prognosis can be made. These tests need not be very elaborate or complex, and it is my opinion that the combination of blood-urea estimation and the urea concentration test will in practically all cases afford all the evidence that can be obtained, even when the most elaborate investigation is carried out. Experience has amply proved that when the clinical condition does not agree with the result of the tests, then the tests are much more reliable. The clinical condition is often deceptive, and the patient on the verge of acute uræmia may be apparently quite fit clinically a few weeks before the uræmic symptoms show themselves. In primary cardio-vascular disease with high blood-pressure the outlook is, of course, much better when the kidneys are not involved. In all such cases it is useful to investigate the functional capacity of the kidney. When, however, the results of renal tests are good it is advisable not to express a very definite opinion until another renal examination is carried out from three to six months later. If, on the second examination, the results of kidney tests are still quite good the prognosis is fairly hopeful. It is noteworthy, however, that very marked renal changes may ensue in apparently healthy kidneys within a few months of the advent of the blood-pressure changes.

Dr. LANGDON BROWN

said that he found himself in close agreement with Professor MacLean. Fifteen years ago, in opening a discussion on nephritis, before another Section of the Society he had stated that the orthodox treatment was then based on four principles, each of which he believed to contain, and, indeed, to be based on, a fallacy.[1] These were: (1) Severe restriction of protein intake. (2) The daily output of urea as a guide to the efficiency of the kidney. (3) "Flushing out" the kidney by diuretics. (4) Elimination by the skin, promoted by various diaphoretic measures.

In the acute stage, when nitrogen retention was usual, he thought that von Noorden's plan of restricting the diet to one of fruit juice and sugar for two to three days gave good results. But during the hydræmic stage the power of the kidney to eliminate nitrogen was retained as long as the protein intake did not exceed about 96 grm. a day, and there was no need for severe restriction. Indeed, Epstein had gone to the other extreme and advised a diet rich in proteins. He was not prepared to go as far as this, and preferred, with Professor MacLean, to rely on the natural diuretic of the body, in the form of urea. In the hydræmic stage it was only the excretion of substances that could be useful to the body which was impaired—for these the kidney interposed a threshold. When the azotæmic stage was reached the general concentrating power of the kidney was impaired, and so all substances, waste or otherwise, were excreted with difficulty. Urea retention therefore occurred and the urine of necessity remained dilute. In this more chronic stage the intake of protein must be more restricted, and extractives should be forbidden.

Now that we realized how completely the proteins of the food were broken down into simple amino acids during digestion, we saw that it was impossible for proteins to run through, and that it was, therefore, impossible to diminish albuminuria by lowering the protein intake.

(2) Since the greater part of the urea in the urine came from the food, it was naturally diminished when the patient was put on a diet poor in proteins. Yet

[1] *Proceedings*, 1910, iii (Therap. Sect.), p. 138.

this was often taken as evidence of the impaired power of the kidney to excrete nitrogen. The diet was therefore still further restricted, and the urea output fell again. In this way the physician might be led to give a diet which in effect meant nitrogen starvation, and this a nephritic was no more able to stand than anyone else. The power of the kidney to excrete urea in a concentrated solution was a far better guide, and we were much indebted to Professor MacLean for the concentration test, which was such a help in estimating renal efficiency.

(3) He did not need to discuss the question of "flushing out." Professor MacLean had shown that this was impossible, and he quite agreed with this view.

(4) As for diaphoresis, drugs given to effect this end were often depressing. The hot-air bath was said to lead to the elimination of urea. To a certain extent this might be true, but he had found that analysis of the sweat produced by this treatment showed that it was very rich in sodium chloride. Excretion of this would diminish the osmotic pressure in the tissues, and therefore would diminish the hold-up of water there. In support of this he referred to the diuresis which might follow the hot-air bath. Sweating did not normally excite diuresis, and its occurrence after the bath showed that some impediment to urinary excretion had been removed. This was the salt. He considered the usefulness of the hot-air bath was limited to those cases with definite œdema; the occurrence of diuresis after it, and the onset of sweating at a lower temperature on successive days, were signs that the bath was doing good. In cases without œdema the bath did not do so much good, and might contribute to exhaustion of the heart.

It was true that in health 92 per cent. of the nitrogen yielded by the hypobromite test came from urea, but this was not so in disease. The urease test only gave nitrogen from urea, and if the results of this test were compared with the hypobromite test it would be found sometimes that as much as 33 per cent. of the nitrogen came from other sources than urea. These were presumably the toxic substances, since urea was not toxic at all.

A former house physician of his, Mr. J. W. Poole, had suggested that by giving hydrochloric acid these toxic amines could be converted into harmless ammonium chloride. Whether this was chemically possible as the result of giving 10 to 15 minims of dilute hydrochloric acid three times a day, he did not know, but he had certainly seen a great reduction in these substances in the blood following this treatment. In one case the blood "urea" gradually fell from 500 mgm. to about 70 mgm. and the condition of the patient was extraordinarily improved.

He thought that the position of the patient with nephritis would be improved when the profession recognized that many of the orthodox remedies employed were useless, if not actually harmful.

Dr. Lewis Smith

emphasized the need for careful diagnosis between the various causes of albuminuria, and especially the recognition of damaged kidneys as opposed to progressive nephritis.

As regards diet in true nephritis, he was inclined to think the pendulum had swung too far, and was convinced that in most cases considerable limitation of the protein element was wise. His experience of the Epstein diet in cases accompanied with gross œdema had not been convincing.

He considered the skin was too little used as an organ of excretion in cases of damaged renal efficiency.

He was of opinion that the modern tendency in diagnosis and prognosis of nephritis relied too entirely on chemical factors, and mooted the possibility of an internal secretion from the kidneys, the loss of which was a probable factor in uræmia. He quoted instances in which very considerable benefit had seemed to accrue from the administration of various preparations of kidney substance.

Dr. A. Bousfield (Highgate)

said that in general practice in a fairly prosperous neighbourhood acute nephritis, in his experience, did not occur. On the other hand, chronic renal disease was very common, as was also pyelitis and cystitis, so that he entirely agreed with the statement of Professor MacLean about the rarity of chronic parenchymatous nephritis.

As to prognosis, he referred to a case which twenty-five years ago was thought to be in a very serious condition, with subacute nephritis, with a large amount of albumin. It eventually was shown that the bulk of the albumin was due to a stricture of the urethra and urethritis, and at the present time the patient was 80 and in excellent health.

As to treatment he advocated prevention rather than cure, and this might be brought about by putting to bed the patients in all cases of acute infection. To indicate the resistance of kidneys to toxic material, he quoted cases of acute cystitis due to excess of (1) rhubarb, (2) claret and (3) beef, beer and port, which all rapidly cleared up with no damage to kidneys.

Dr. R. S. Allison (Ruthin Castle).

We are indebted to Professor MacLean for giving us the means, within the scope of everybody, of studying and estimating renal function. At Ruthin Castle we get the type of case which is seen rather in private than in hospital practice. In the hospital class the case would seem to be more clear cut, more advanced clinically and pathologically. The type of patient we are constantly getting is the man or woman in middle life complaining of headache, giddiness and gastro-intestinal disturbances, having a high blood-pressure and a trace of albumin in the urine. Here the prognosis is undoubtedly difficult, and one wonders how far it is possible to assess the functional activity of the kidneys.

Until the spring of this year we had been using the urea-concentration test of Professor MacLean. My attention was at that time drawn to an article by Calvert in the *British Medical Journal*[1] proposing a modification of the original concentration test, and since April we have been trying this. The essence of the test as proposed by Calvert is that 15 grm. of urea are given at bed-time and the urine collected until 7 a.m.; in a healthy subject this specimen would contain a maximum percentage of urea. At 7 a.m. two pints of fluid are given and the ability of the kidneys to excrete this observed until 9 a.m. This second specimen of urine would contain the minimum concentration of urea. We have been obtaining very satisfactory results with this test, particularly in those cases in which the urea-concentration test has given an anomalous result, such as 2·7 per cent. before the test, 2·4, 2·5, 2·6, one, two and three hours after, respectively. This result, though proving the ability of the kidney to excrete urea, gives little information of the excretory power for water. The concentration of the urea in the resting specimen is practically the same as that in the first-, second- and third-hour specimens. It is here that the test above outlined comes in usefully; in the same patient the night urine collected at 7 a.m. was 2·5 per cent., indicating the maximum concentration of urea, whereas after the patient had taken two pints of water the concentration of the urea was only 0·5 per cent., showing a range of 2 per cent. between maximum and minimum concentration. As a rule the patient sleeps comfortably through the night, and the test causes little, if any, inconvenience.

Leaving out of account the cases of renal disease with well marked signs and symptoms and turning our attention to those border-line cases the symptoms in which arouse the suspicion of renal disease, I have in mind seven such cases which will bear comparison with seven normal controls. The ability to excrete urea in each was good; in the cases under suspicion it varied from 2 to 4 per cent., in the normal

[1] *Brit. Med. Journ.*, 1925, i, p 64.

controls from 3 to 4·5 per cent. On the other hand, there was a difference in their ability to obtain diuresis after drinking the water. The average figure obtained in healthy cases was 0·7 per cent. of urea, but in the suspected cases the percentage of urea was above 1 per cent. What does this mean? In attempting to throw light on the problem the hours from 7 to 9 were extended to 7 to 11 a.m., so that four hours were given for the kidneys to excrete the water instead of two. In a typical suspected case the figures obtained with this modification were 3·9 per cent. for the night urine, 1·7 per cent. for the urine collected between 7 and 9, and 0·6 per cent. for that collected between 9 and 11 a.m. From this it will be seen that there was evidently some delay in the excretion of the water. Whereas this point may not be of significance, on the other hand it may be that when there is slight damage of the kidneys the excretion of water is delayed longer than the normal, and this may be used in detecting fine degrees of renal impairment.

In a series of cases of acute nephritis in children, the after-histories of which I was enabled to follow up, I found that in a good majority there were enlarged tonsils and adenoids which were in a state of chronic inflammation. From the results of their removal it could hardly be doubted that these were important ætiological factors in the production of the disease. The most severe constitutional symptoms were associated with massive hæmaturia and slight œdema, and, curiously enough, although it is stated to be a pronounced symptom, scanty urine was not a feature in any of the cases. The blood urea was raised in a few and returned to normal with subsidence of the acute symptoms. When examined a year later with the usual tests for function activity the patients appeared to be healthy and to show no trace of disease.

Dr. H. A. Ellis

stated that his investigations showed that the renal or cardio-renal disease occurred in the acid-group type, that is, those who had, on urinary analysis, the free acid and their ammonia-combined acid in the ratio approaching equality or unity, in contra-distinction to the alkaline group, the ratio of which between the free-acid and ammonia-combined acid approximated the ratio of three to one. This latter constitutional group only acquired renal disease as the result of secondary infection of the bladder and kidney pelvis, the alkaline group being much more subject to septic involvement, which rarely occurred in the acid group, this group being naturally far more resistant to germs.

Renal disease was largely a question of excess metabolism and kidney strain resulting from the elimination of excessive waste causing renal degeneration, which had to be controlled if deterioration was to be avoided. He said that he was old enough still to believe in the help in this direction that could be obtained by using the skin and bowels as an aid to relieving the kidneys of some of their difficulties. He had found that the following method yielded considerably better results than would normally be obtained from other treatment: (1) Rectal injections of magnesium sulphate up to 2 oz., as well as its oral administration in small doses until the bowels acted copiously; (2) in addition, $\frac{1}{100}$th gr. of physostigmine by the mouth two or three times daily.

Section of Medicine.

DISCUSSION ON THE MODERN CONTROL OF INFECTIOUS DISEASES.

Sir JOHN ROBERTSON, C.M.G., O.B.E., M.D. (M.O.H. of Birmingham).

THIS is obviously a very wide subject. I must, therefore, ask indulgence for confining my remarks to certain general principles rather than to dealing with certain of the matters involved in the detail which these diseases really merit. Also, some of the newer methods are comparatively untried, and I do not think are yet open to general discussion.

There are certain generalizations which must be kept in mind.

(1) Perhaps the most important of these is that there are no two infectious diseases which can be successfully dealt with from a preventive point of view by identical methods. In the eyes of the general public, and indeed of the medical profession, a small living particle which we call infection is transmitted directly or indirectly from one patient to another. It is not, therefore, remarkable that there is an inclination to apply to all diseases due to infection the same methods of control.

(2) The better our knowledge becomes of the natural history of any one of these diseases the better become our methods of control, and the less need we have for inquiring into evidences of mysterious epidemic influences about which a great deal was talked in the years that are past.

(3) In considering the efficiency and examining the results of our methods I am certain it is wise to keep in mind the fact that the standard of general intelligence among the masses of the people is very much higher now than it was when preventive medicine first took the prominence it takes to-day. There is, of course, a very great deal of ignorance, but alongside this there is the fact that there are a great many people who are now very much more careful and know very much better what to do to avoid infection than formerly.

I would first ask you to consider very shortly what has been accomplished, and for this purpose we have to take into consideration the two types of statistics—one of mortality and the other relating to the incidence of the disease.

For the first of these I append diagrams showing the mortality rates for some of the infectious diseases. These are based on the Annual Statistical Review of the Registrar-General.

Anybody looking at these could not fail to appreciate the enormous decline in mortality which has taken, and is taking, place from these diseases.

It is by no means easy to give an explanation as to why many of these diseases have declined in mortality. There is no doubt that the type of the disease is milder in many cases, but why this should be so I am not prepared to offer any explanation.

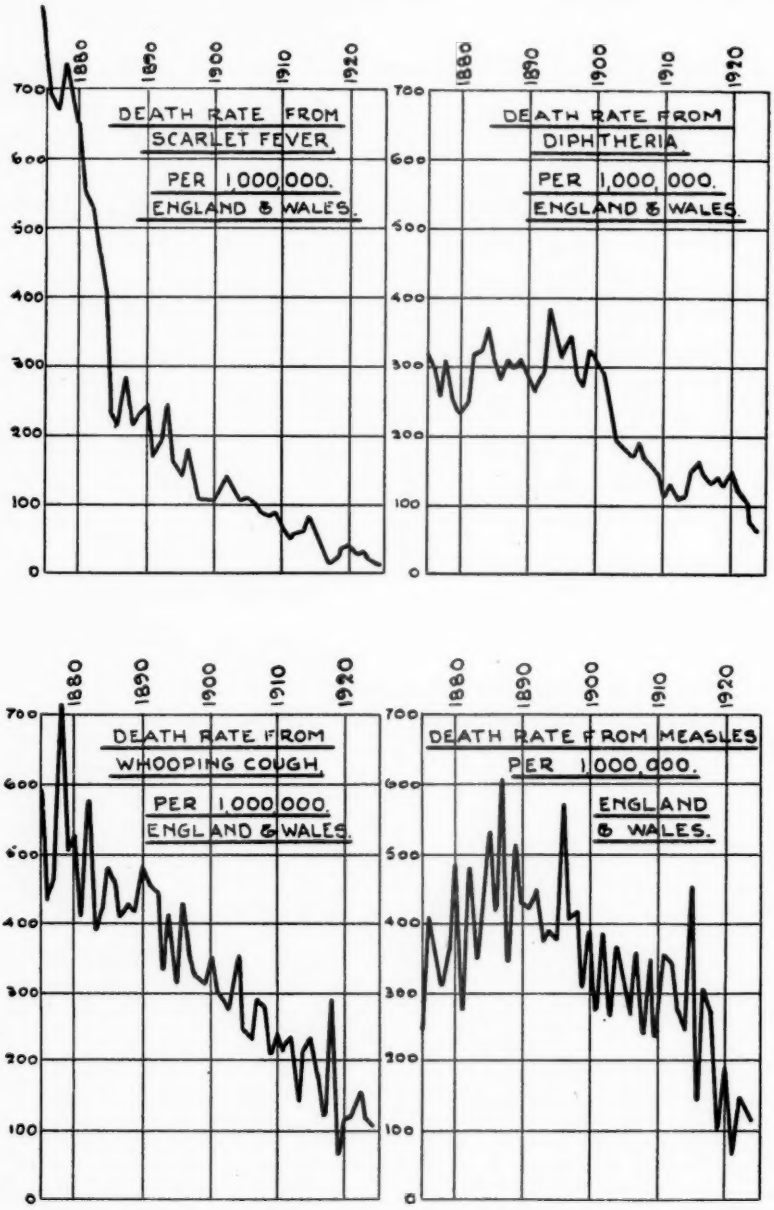

Diagram of Mortality I.

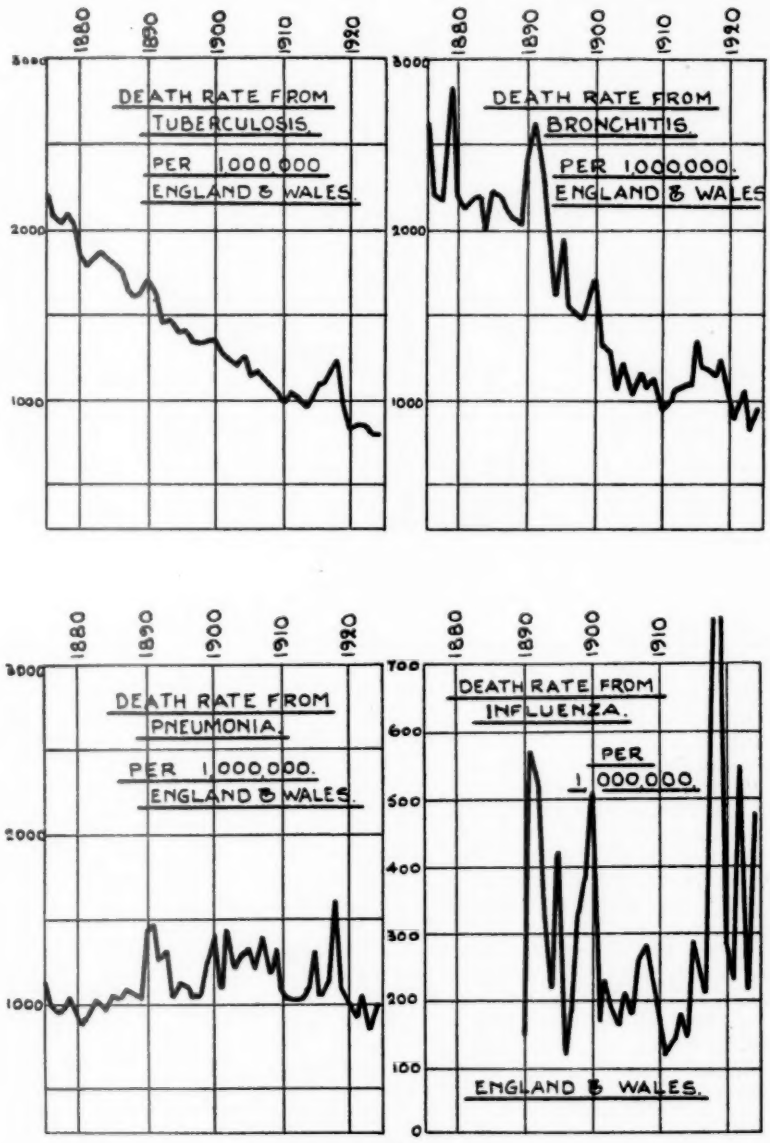

Diagram of Mortality II.

Statistics showing the incidence of these diseases are very much less satisfactory. It is true to say that there is some decrease in incidence in the majority of

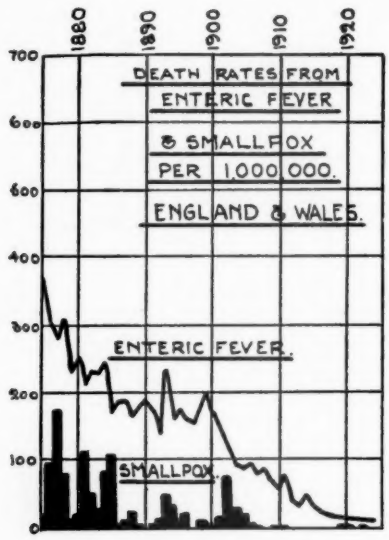

DIAGRAM OF MORTALITY III.

cases, but the facts in regard to incidence have to be taken into consideration together with many other circumstances, such as—

(1) No medical assistance is sought for in mild attacks, and, therefore, the cases do not get notified.

(2) In a good many other mild attacks the question of diagnosis will arise and often occasion great difficulty.

(3) The number of missed cases, therefore, in a town population is considerable.

To a limited extent also, cases of infection among young children cannot be so numerous at present, because the number of such children in the population is less than it was, say, fifty years ago. In every 1,000 of the population in 1871 there were 361 children under 15 years of age, while in 1921 there were only 277, i.e., a difference of eighty-four in children under 15 in every 1,000 of the population.

It is a fact, however, that there are several infectious diseases that apparently have been satisfactorily dealt with so far as England is concerned. As examples, I would mention small-pox, typhus fever, plague, cholera and enteric fever.

In the past we have applied four methods in our attempts to limit the spread of these infections—(1) notification, (2) isolation, (3) quarantine, (4) disinfection.

Within recent years we have added immunology both to the prevention of these diseases and to their treatment. Each disease responds in an entirely different way.

SMALL-POX.

Speaking generally, there can be little doubt that the best results we have ever obtained in the prevention of an infectious disease are those from the active immunity which we produce by vaccination against small-pox.

It is somewhat remarkable that this is our oldest example of immunization. Those of us who have to deal with small-pox—without a single exception—are able to affirm that recent efficient vaccination is about as absolutely a certain method of prevention as anything we know of in the whole art of medicine. It is true that we have learned a good deal about the duration of vaccinal immunity in different individuals. We have learned also a good deal about the immunity produced by an attack of small-pox itself. I think there can be nobody who has been responsible for the prevention of small-pox who is not agreed that the disease can be entirely abolished by general vaccination and revaccination.

In a community such as we have at present, where from 30 to 40 per cent. of the people are unvaccinated, and an additional number imperfectly protected by vaccination, we have to bring into operation isolation and quarantine. In the case of small-pox, isolation and quarantine are extraordinarily satisfactory if carried out with intelligence and vigour. The only real difficulty which exists is due to the fact that at all times, and particularly at the present, a number of cases of small-pox are so mild as to escape notification. It is, indeed, remarkable that in the case of a disease in which our method of immunization is so satisfactory we should know so little of the organism involved. The recent work of Dr. Mervyn Gordon and of some French bacteriologists gives some promise that in the near future our knowledge on this subject may be extended.

In the case of small-pox there is apparently very little natural immunity, that is to say, few unprotected people escape small-pox if exposed to the infection. A point of some interest is that in my experience the infection of small-pox is comparatively easily killed by exposure to light and air, and in this respect is somewhat similar to the organisms producing measles, whooping-cough, influenza, pneumonia, &c. On the other hand, infection from these ailments which happens to be shut away from light and air, as occurs when the leaves of a book become infected, is apt to retain its vitality for considerable periods.

Scarlet Fever.

In an entirely different category is scarlet fever, in which natural immunity plays an important part in limiting the number of cases.

The work of Dr. and Mrs. Dick has by experimental methods demonstrated what many of us recognized to be an important fact in the spread of scarlet fever, viz., that natural immunity played an important part. I have always recognized that somewhere about 12 to 20 per cent. of children under 15 years of age were at one or other time susceptible to scarlet fever, while the rest of the children either by natural immunity or by absence of exposure to infection escaped the disease. I am convinced, however, that natural immunity does play a very important part, not only in preventing the disease, but in reducing its virulence.

In this connexion it is well to recognize that the infection of scarlet fever is not a very diffusible one, and therefore the number of persons who escape infection on this account may be considerable. In this respect scarlet fever differs from measles, small-pox, whooping-cough, and many other ailments.

If we could have perfect bed isolation it would be possible to treat cases of scarlet fever in the ward of a general hospital without much fear of infecting other patients, but, unfortunately, perfect bed isolation is most difficult to obtain. Zingher has shown as a result of the Dick test applied to very large numbers of children that 44·8 per cent. of infants under 6 months of age are Dick-positive, 71 per cent. of children from 1 to 2 years of age are Dick-positive, but only 16·8 per cent. of young people aged from 15 to 20 years are Dick-positive.

Dr. Harries, the medical superintendent of the Birmingham fever hospitals, who has done a considerable amount of work with the Dick test in scarlet fever, finds that

in schools and other institutions the percentage of Dick-positive reactions may be shortly summarized as follows:—

Age	No previous history of scarlet fever. Percentage positive
0 to 5	70 per cent.
5 ,, 10	64 ,,
10 ,, 15	56 ,,
15 ,, 20	18 ,,
Over 20	11 ,,
All ages	47·5 ,,

In persons of all ages who had a history of having had scarlet fever at a previous time the percentage of Dick-positives was 3·9.

These results confirm what one finds in many areas of England where there is not sufficient hospital accommodation. In former days my own experience indicated that it was not an uncommon thing to come across cases of scarlet fever in a court-yard where the children with the disease were playing amongst other children without these other children catching the infection. In other cases it was not uncommon for the whole family to become infected.

As regards the active immunization of patients against scarlet fever, experience is not yet sufficient to warrant its general use as a means of prevention. A large amount of work is being done on this account at the present time, and the results all go to indicate that it is possible to produce an efficient immunity and to use certain of these methods in cutting short and modifying the attack of the disease. Many hospital superintendents are making use, with very good results, of the work which has been done, and I have no doubt whatever that in the very near future it should be possible for any medical practitioner to protect entirely any individual against an attack of scarlet fever.

We have attempted to limit the spread of scarlet fever by isolation, quarantine, and disinfection, and I think it will be recognized from the figures showing the incidence of scarlet fever in Birmingham, or, bettter still, the incidence of scarlet fever in any town where efficient hospital isolation is available, such, for example, as in London, that such isolation has not been successful in limiting the spread of cases of the disease.

For nearly thirty years I have kept statistics indicating the effect of isolation in the prevention of scarlet fever, and long ago came to the conclusion that isolation as a means of control is of very little value to a community.

On the other hand, isolation is a great convenience to the public. It is, too, of great value to the patient who is acutely ill. It has, however, certain very considerable disadvantages, and among these is the fact that unless the discipline in a scarlet fever hospital is exceptionally good, children are very apt to contract not only other varieties of their own scarlet fever infection, but infection from other diseases, such as measles, whooping-cough and chicken-pox, and septic throat conditions.

Theoretically, one would have asserted most positively that the isolation hospital must, of necessity, do good in limiting the spread of infection in the case of scarlet fever. This belief is so strong on theoretical grounds that there are few who can contemplate with impunity the abolition of the scarlet fever hospital. But for its convenience to the public and its value in treatment, I would say that home isolation for all but the poorest or for the most severe cases is sufficient isolation for scarlet fever.

There seems to be no doubt that in the case of scarlet fever and also in the case of diphtheria where the community is crowded, the number of immune persons is largest. Theoretically, it has been suggested that this is due to widespread mild infection which immunizes these people in the towns. It is certainly true that

scarlet fever spreads more rapidly in a sparsely populated area than in a densely crowded one. It is usually exceedingly difficult to trace the source of infection of scarlet fever in a town district, whilst in a rural one such evidence of the source of infection is comparatively easily obtained.

It is not sufficiently recognized, I think, that the discharge from the throat, nose and ear in scarlet fever is very highly infectious, while little attention need be paid to the desquamation, were it possible to separate this from the other sources of infection.

It has not been possible to demonstrate bacteriologically the existence of "carriers" in scarlet fever cases. Up till recently we have not recognized the specific organism. There is no doubt about the mild, almost unrecognizable, case spreading the disease, and, equally, there is no doubt about throat infections being capable of spreading it.

Scarlet fever is now a mild disease, with an attack rate, during the past ten years, in England and Wales, of 2·68 per 1,000 of the population and a fatality rate in Birmingham of only 1·09 per cent. I have, however, known an isolated outbreak of eighteen cases with a mortality rate of 83 per cent. It frequently happens that even now very severe anginous or hæmorrhagic cases occur, particularly at the commencement of an epidemic prevalence.

Medical officers in charge of large residential schools are aware how difficult it is to stop an outbreak of scarlet fever by isolation and quarantine, and how frequently these outbreaks are due to cases that are so mild as to be unrecognizable. When a good antitoxic serum is used these difficulties should disappear.

For the present, then, I think we must rely upon our old methods of isolation and disinfection in the prevention of the spread of this disease, with the hope that in the near future the work which is being investigated by so many experts in regard to immunization will give us a satisfactory method of limiting the incidence of scarlet fever.

I should like to add here that Dr. E. H. R. Harries has supplied me with a large amount of information in regard to the recent methods of diagnosis and of treatment of scarlet fever by sera prepared by Dr. O'Brien. These results will shortly appear in print. I am greatly indebted to these gentlemen for much knowledge about recent work.

Diphtheria.

Diphtheria is a disease in regard to which hospital isolation, quarantine, and disinfection have apparently accomplished nothing in the way of prevention. About as many new cases occur now as formerly. The mortality, however, has greatly diminished during the past fifty years, as will be seen from the diagram (p. 8). I am aware that the certification of the cause of death in this disease has not remained uniform during the periods shown, but I believe the indication in the diagram of a great reduction in mortality is correct.

We have everywhere the knowledge that the fatality rate has enormously declined. In Birmingham thirty years ago it was approximately 30 per cent. Now it is about 5 per cent.

Most cases of severe diphtheria should be removed to hospital for skilled medical supervision and nursing, but not necessarily as a means of preventing the spread of the disease.

The carrier problem was first discovered in the case of diphtheria. There can be no doubt that the disease is spread by carriers. We have now divided these carriers into two groups, viz., virulent and non-virulent, and are now devoting attention to the so-called virulent carrier. In a small household or an institution it is not difficult to find such a virulent carrier, but when one comes to deal with a community as a whole the problem of attempting to find virulent carriers is an

impracticable one. In my experience a very large number of virulent carriers do not do as much damage in spreading the disease as would be expected on theoretical grounds.

The virulent carrier cases may be subdivided into two groups, viz. (*a*) those who are in a carrier condition and in whom the throat will clear up in a few weeks, and (*b*) those who are chronic carriers, mainly because they have diseased tonsils, often associated also with adenoids.

For this latter group the otologist is most helpful in clearing up the carrier condition.

There is a great deal of evidence that the diffusion of the *Bacillus diphtheriæ* by carriers produces some degree of immunity, and that this acquired immunity protects a large number of the public against attacks of the disease. Unprotected nurses who have worked in diphtheria wards for many years show a much higher percentage of Schick-negative reactions than do nurses coming into such a ward for the first time. So also there is a remarkable difference between the Schick reactions in the slum districts of our big towns, as compared with those in better-class children of the same age.

The Schick test has demonstrated that there exists in many people a natural immunity against diphtheria, and this is confirmed by statistical evidence of the age incidence of the disease.

The New York figures show that something like 93·1 per cent. of positive Schick reactions are obtained among infants under 1 year of age, 60·3 per cent. positives among children aged 5 to 6 years, 29·3 per cent. positives from 10 to 11 years of age, 12·2 per cent. positives from 20 to 30 years of age, and only 5·8 per cent. positives in adults over 30.

Our Birmingham figures, which are not by any means based on such large numbers as the New York figures, show the same diminishing susceptibility. They are as follows :—

From 0 to 5 years	... .	75	per cent. positive
,, 5 to 10 ,,	... ...	62	,, ,,
,, 10 to 15 ,,	... ...	49	,, ,,
Over 15 years ...	... ...	35·5	,, ,,

It is possible at the present time on theoretical grounds to reduce the incidence of diphtheria to a vanishing point by actively immunizing all young children. The results from many American cities of such immunizing methods are extremely good, as are also a large number of results obtained from smaller numbers of children in this country.

Obviously the best age at which to immunize is about two years, and if it were possible to immunize every child at this age it would be unnecessary to obtain a preliminary Schick test, for 80 per cent. of children at this age are Schick-positive. It is between two and eight years of age that the greatest number of cases of diphtheria occur.

The method at present in use of giving three injections of toxin antitoxin, or rather in England of toxoid, plus antitoxin, produces an active immunity in 60 to 80 per cent. of the cases, and a considerable portion of those who, in the first instance, fail to develop active immunity obtain such immunity by a further course of toxin antitoxin.

This immunity certainly lasts for a great many years in most cases, but as yet there is not sufficient experience to justify one in saying more than that it will protect the child over the period of greatest danger. Experience shows that this immunization reduces the risk of infection from 70 to 90 per cent.

I think it may also be said that the method is now safe.

Another group of people among whom this immunization has been of the greatest value is the staff attending on diphtheria patients in hospitals. Dr.

Harries, the medical superintendent of our city fever hospitals in Birmingham, has devoted a great deal of attention to the immunization of his staff and has obtained striking results.

CITY HOSPITAL, LITTLE BROMWICH.

Year	Average number of diphtheria cases admitted per annum	Average number of female staff at work	Average number per annum of cases of diphtheria among staff	Remarks
1916-22 ...	941 ...	123 ...	18 ...	No immunization
1924 ...	1,734 ...	153 ...	6 ...	Active immunization of nursing staff
1925 ...	2,005 ...	125 ...	1[1] ...	Active immunization of nurses and maids

[1] Contracted diphtheria in scarlet fever ward one month after T.A.T., markedly Schick-positive at time of attack.

Immunization would appear to be by far the best preventive measure against diphtheria. Unfortunately, it is not being as extensively used in England as it ought to be, because our people have a rooted objection to inoculations or injections of any kind. Among the general public we find that the most frequent source of objection is the father of the child, because he has a vivid recollection of the uncomfortable time he or some of his friends had during the war when antityphoid inoculation was general among the Forces. It is probably true to say that the medical profession have as yet not become familiar with the technique and the value of immunization against diphtheria.

TUBERCULOSIS.

Tuberculosis shows a diminishing incidence and mortality practically everywhere throughout the civilized world.

In the city of Birmingham where there is in force a fairly well-developed campaign against tuberculosis, there were notified during the years 1923, 1924 and 1925 6,153 new cases, while in 1913, 1914 and 1915 there were 12,529 cases notified, i.e., a reduction on an average of nearly 2,000 cases per annum on the figure of ten years ago, and this notwithstanding the fact that there is an increase in the population.

Spread of knowledge of the disease, better hygienic conditions, including better food, and the isolation of large numbers of chronic cases are supposed to be the factors in the causation of this decline.

The world question in regard to the incidence of tuberculosis among many races has led to the belief that there is a primary immunity due to repeated infections in the dwellers in a civilized community. Immunity reactions and pathological findings tend to confirm this theory, and tuberculosis fits in with many of the epidemiological facts, but not with all of them. I must, however, content myself here with the mere mention of this primary immunity in our country.

So far as I know none of the attempts which have been made to immunize further against tuberculosis have been successful, or have only been successful to a somewhat limited or doubtful extent.

Early and prolonged treatment on hygienic lines appears to provide the best results so far as treatment is concerned. There are a certain number of people, however, who cannot apparently be influenced by any hygienic treatment that we know of, and these cases run in families. The infective agent of tuberculosis can, of course, be easily demonstrated in the dust of dwellings where careless consumptives live, and such dust contains the living organism.

If we apply to the case of a tuberculosis patient our knowledge as to how the *Bacillus typhosus* escapes in the fæces from a clean and intelligent typhoid carrier it will be readily understood how easily infection may be spread by the tuberculous person handling transferable articles as well as by a spray infection and sputum.

I have had a good deal of interesting experience in getting farmers to keep their herds of cattle free from tuberculosis. When such a herd is free, it has been quite remarkable to note how easily infection is spread once an infected animal is introduced into the herd. In such a case the infection of tuberculosis seems to be as diffusible as that of measles. There appears to me to be, therefore, a definite need for a certain amount of isolation for every case of advanced pulmonary tuberculosis. The isolation may take the form of placing the patient in good hygienic surroundings.

It does not seem to me that the tuberculization of the people will account for the rapid reduction in the number of new cases and deaths which take place in any area where good anti-tuberculosis work is being done, and that either the hygienic measures are successful, or that there is some other influence at work, which may be general and may be causing the decline in mortality from so many other infections as well as tuberculosis. I should hesitate to feed young children on milk containing proper doses of tubercle bacilli. Yet this is in essence what is meant by the primary tuberculization of the people. Nor would I advocate the presence of a mildly infecting consumptive as an immunizing agent in our midst.

There can be no doubt now that robust good health is our best preventive measure. There is evidence in a good many cases that massive doses are required before one gets infected, but this does not account for the majority of cases, e.g., the cases of familial infection. In our crowded towns we meet daily with a large number of cases in which an infected husband or wife or other member of the family occupies the same bed without spreading infection, and yet we know that the particular case is an example of massive doses being ejected.

Measles.

Measles has caused on an average 3,549 deaths in England and Wales during each of the past ten years. No other diffusible infection kills so many on the average. The chart (p. 8) indicates clearly that a considerable reduction in mortality has recently taken place, but there is no evidence that the incidence of the disease has declined *pari passu* with the mortality.

Hospital isolation is of little or no value in preventing the spread of the disease, mainly because the period of greatest infectivity occurs before the disease is recognized. Some authorities undoubtedly lower the mortality from measles by admitting to hospital neglected children with measles complicated with bronchopneumonia.

Disinfection in the ordinary sense of the word is almost valueless, as the infective agent undoubtedly dies very rapidly on exposure to air and light.

For nearly thirty years it has been the custom in many towns to allow a child who has once had measles to continue to attend school when another member of the family is suffering from measles at home. On several occasions I have inquired into the success of this procedure, and am satisfied that infection is not carried to the school by such an arrangement.

At rare intervals one hears of cases of measles being spread by letters, but air and light seem to kill the infection very rapidly.

One very notable feature in the spread of measles, and indeed of several of the respiratory infections, is the fact that the rate of spread in an infants' school depends very largely upon the ventilation. In an open-air school measles seldom spreads to any extent, while in a badly-ventilated infants' school one case will infect nearly all the children. We had a very satisfactory confirmation of this method of spread of respiratory infections during the war. In a great many cases it was possible to check the spread of measles, cerebro-spinal fever, septic sore throats, and other ailments by merely separating the men in their hutments by leaving a larger space between them and ventilating the huts properly.

From 90 to 95 per cent. of the children attending our public elementary schools contract an attack of measles before leaving school at the age of 14.

Up to the present there has been no successful attempt at immunizing children against measles, but Professor Debré and Dr. Joannon, of Paris, have recently demonstrated that temporary immunity may be obtained by the injection of a serum taken from a measles convalescent. They have also demonstrated fairly satisfactorily that such a serum injected into a person on the sixth to the tenth day of incubation produces such a mild attack of the disease as almost to be unrecognizable. Their work is being repeated in America and in Germany, and already two clinics have been established in Paris for the application of the method.

ENTERIC GROUP. *Bacillus typhosus*, *Bacillus paratyphosus* A, B, and C.

The diseases caused by these organisms have nearly disappeared in England. Most of the evidence goes to show that better general sanitation in the direction of more efficient removal of decomposable refuse and excrement, and the provision of pure water supplies, have been the main causes of this decline in the incidence of enteric fever. There are numerous instances in which the provision of a wholesome water supply has been the immediate cause of a great reduction. There is an equal number of instances in which removal of excrement from the precincts of dwellings has diminished the incidence of the disease.

There seems to be no doubt also that cleaner oysters, mussels, cockles, and perhaps estuarial fish have played a part in reducing the incidence of this disease. Both as regards incidence and mortality it is now one of almost negligible importance from a public health point of view,

The enteric carrier has given us a great deal of information. A carrier of dirty habits is known to do a great deal of harm, but in the great majority of cases the carrier appears to do little or no harm. Doubtless flies were the means of spreading infection, but the decline in the incidence of enteric fever commenced long before there was any great reduction in the number of flies in autumn.

We have never, therefore, in this country undertaken a warfare against typhoid carriers similar to the abortive "Typhus-Bekämpfung" of the Germans. In lunatic asylums there appear to be always a few carriers, and as most of these are dirty in their habits, it is essential that they should be segregated and that the nurses or attendants should be kept in a constant condition of immunity, as was the case with most of our soldiers during the war.

Wright's method of active immunization is one of the great achievements of English medicine in recent times. It is reliable and easy of accomplishment, but except during war-time, or in the case of British people going into districts endemically infected, it is not necessary now.

For many years we have treated enteric cases in the ordinary wards of general hospitals without spreading the infection, except, perhaps, in the case of careless nurses.

Disinfection in the case of enteric fever may be limited to the dejecta and articles coming in contact with the patient.

Here, again, the isolation hospital has not played an important part in preventing the disease, although hospital treatment is in the majority of cases necessary. The essential feature in the prevention of enteric fever is the avoidance of recent fæcal contamination.

BRONCHITIS AND PNEUMONIA.

I have constructed charts to show the mortality from these two diseases (see p. 9).

In the case of bronchitis the Registrar-General includes under these headings all varieties of bronchitis and all varieties of pneumonia. It will be noted that a

considerable reduction has taken place in the mortality from bronchitis. No figures, however, are available in regard to the incidence of the disease. It is interesting to note the relationship between the decline in the mortality from bronchitis and that from pulmonary tuberculosis, because it has on many occasions been alleged that some of the deaths from bronchitis ought to have been included in the group of deaths from tuberculosis.

As far as I know, no authority has yet succeeded in immunizing against bronchitis or in increasing the resistance for treatment purposes when an attack occurs.

Pneumonia, on the other hand, also includes a variety of diseases, viz., broncho-pneumonia, lobar pneumonia, &c., under the one heading. Whilst very little has been done in the direction of immunizing against pneumonia, a good deal of work has been done in recent years on the bacteriology of the disease and on the production of toxins and antitoxins for the treatment of the disease. I think it would be fair to say that no general consensus of opinion has yet materialized as to what variety of serum treatment is best, but there seems to be little doubt that in the case of acute illness the patient should be removed to hospital and put under the charge of an expert, under whose care modern methods of treatment may be carried out—methods that are very difficult to carry out elsewhere except in a wealthy man's house.

I am refraining from commenting on the incidence of influenza, cerebro-spinal fever, encephalitis lethargica and poliomyelitis, because our knowledge of the prevention of these diseases is so extremely fragmentary and unsatisfactory.

In conclusion, I would ask whether there is not some non-specific general immunization of the people taking place, which produces the decline shown in the diagrams and about which we may know nothing at the present time.

There seems to be no reason to suspect that inaccurate diagnosis or statistical errors explain the diminution in mortality. Methods of treatment by the general medical profession have undoubtedly improved, and I think some credit may be taken by those engaged in the healing art, but this will not account for the very fine results obtained.

In most of the epidemic diseases only a very small number of the people who are apparently exposed to risk succumb to the infection. This is very well marked in the case of milk-spread or water-spread or shellfish-spread epidemics. In these cases somewhere between 10 and 20 per cent. of those apparently exposed to the infection contract the disease.

Why is it that the 80 or 90 per cent. of these people escape?

There seems to be no doubt that notification of infectious diseases has been of great value. It has drawn attention to many problems which have emerged as the result of investigation into the conditions surrounding each case. While this is so, there are several infections in regard to which notification has as yet achieved nothing.

In my opinion hospital isolation has undoubtedly not produced the results which were expected, and, therefore, it is undesirable at the present time to talk of these hospitals as isolation hospitals. They are hospitals for the treatment of certain infected persons.

As regards the general question of disinfection, there can be no doubt that the organisms producing measles, whooping-cough, and many other diseases are so easily killed by exposure to air and sunlight that there is no necessity for any particular form of disinfection. On the other hand, in the case of scarlet fever and diphtheria, and perhaps in a good many other infections, it is desirable that articles coming in close contact with the infected person should be disinfected by being efficiently washed or passed through a steam chamber. For most rooms occupied by infected persons thorough house cleaning is all that is required; indeed, the

hospital surgeon who requires his operating theatre to be kept clean by aseptic methods has indicated to us the way in which we ought to treat the rooms occupied by infected persons. It is certainly no longer necessary to burn sulphur or liberate chlorine gas.

Dr. C. R. Box

said it was evident that there were no stereotyped methods of control which were applicable for the prevention of all infectious disease. It was only by increasing our knowledge of the nature, cause and manner of spread of such diseases as well as of the problems of bodily defence, that appropriate methods of dealing with the individual infections could be evolved. A method useful in one disease might be quite ineffective in another.

Success in a campaign of this sort would be helped greatly by a spread of knowledge among the general public and it might materially lessen the objection to protective inoculations.

He much doubted whether a specific natural immunity to any infective disease could be said to exist, and suggested that in all cases "natural" immunity was set up by repeated minimal doses of infection which activated the natural defence mechanism of the body in a special direction.

Referring to special diseases, he thought that the scarlatinal carrier was a very important agent, and he cited evidence that such carriers might spread the disease for many months although themselves free from any clinical evidence of ill-health. A case reported some time ago by his colleague Sir John Broadbent was very instructive in this connexion.

The exceedingly good results of immunization of nurses and attendants in fever hospitals against diphtheria led him to hope that this method would be more widely adopted. Unfortunately there appeared to be still a great amount of prejudice against it.

Dr. E. W. Goodall, O.B.E.

I do not lay claim to an experience on a large scale of methods of control, modern or ancient, of infectious diseases; on the contrary nearly the whole of my professional life has been occupied with the results of the failure or the absence of any such methods. I cannot, therefore, speak at first hand on the subject, except to a very limited extent. But I have interested myself in epidemiological problems, into which the question of human interference, that is of control, enters; so I shall confine my remarks almost entirely to the broad aspect of the subject and shall deal with general principles rather than with details.

To begin with, I need hardly remind this meeting, though I might have to remind some meetings of medical men and certainly some of laymen—in spite of Sir John Robertson's statement regarding the heightened standard of intelligence amongst the masses,—that when we talk of "controlling an infectious desease" we are talking loosely, though perhaps conveniently. We do not control a disease; we control the actions of the human beings or animals that are suffering from the disease, or we control the conditions which may lead to the illnesses of the persons or animals. In respect of infectious diseases amongst these conditions are the presence and activities of certain micro-organisms. Yet there are not a few practitioners who talk and act as if the micro-organism was not only the sole cause of a disease but the actual disease itself. Hence efforts, now proved to be futile, have been directed against the micro-organism, to the utter neglect of other conditions which could have been dealt with more easily and with more hope of success, so far as the prevention of illness is concerned.

Further, in speaking of the control of infectious diseases, I take it we are referring to the control of the disease *en masse*, of epidemics and endemics, rather than of individual cases. The physician who administers an effective dose of antitoxic serum to a person suffering from diphtheria, may be said to be controlling the disease in that person. The aim of the sanitary administrator is to abolish disease, to prevent epidemics and to terminate endemics. Yet he may be compelled, for want of effective preventive measures, to play the part of the clinical physician by providing hospital or even home treatment for the sick, in an endeavour to mitigate and, I think we may say, to control, the severity of the disease. There is substantial evidence that the mortality from diphtheria has been diminished by therapeutic measures; but this is about the only disease in which such a claim has been successfully made.

Sir John Robertson has put before us certain curves as evidence of the fall in the mortality of certain infectious diseases during the last fifty years. In most of the diseases to which the curves refer there certainly has been a notable reduction in the death-rate. But I do not think that we have anything to boast about in the cases of pneumonia and influenza. Sir John admits the ignorance shared by all of us concerning the explanation of this drop in the mortality rates. It may be due to lessened prevalence or lessened severity. It is certainly not due to lessened prevalence in the case of scarlet fever and diphtheria. I have already mentioned that there is evidence that treatment has had a beneficial effect in diphtheria. The epidemiological history of scarlet fever goes to show that the present low mortality from that disease is due to diminished severity, of which no explanation can be given. The fall in the mortality from typhoid fever and small-pox may justly be attributed to a diminished prevalence, and that, again, I think it may safely be said, has been brought about by administrative sanitary measures. An increase in the prevalence of influenza has led to an increase in the mortality.

I am glad to note that Sir John Robertson in referring to small-pox and certain other diseases has been so cautious as to say that they have *apparently* been satisfactorily dealt with in this country. But there is no satisfactory explanation of the disappearance of plague after 1666, *pace* Colonel Glen Liston's suggestion that it was connected with the appearance of the sewer rat and the disappearance of the house rat. Cholera we have kept out of, rather than subdued in, the country, for it was never endemic here.

None of us, I should think, will disagree with Sir John Robertson's generalization that the better our knowledge of the natural history of the infectious diseases, the better become our methods of control. But the amelioration is not always brought about in the expected way. Just as there were those who fondly imagined that notification and isolation combined would enable them to stamp out certain diseases, so there were—and still are—those who acted as though they believed that the discovery and isolation of a few "carriers" of diphtheria bacilli were of use in limiting the spread of diphtheria. Bacteriology has not helped us in the way we expected; it is impossible, even if it were necessary, to segregate the carriers. Bacteriology is of great assistance, however, when properly applied, in diagnosis; misapplied, as it often is, it leads to confusion: it is also of great use in treatment, preventive as well as remedial.

It is now realized by most of us that we cannot get rid of the micro-organisms, save a few here and there, and that we must try to protect ourselves against their attacks. This can be and has been done in four ways:—

(1) By preventing their attack, without destroying them, as in the case of water- and food-borne infections such as enteric fever. Our food and drink can be freed and protected from the micro-organisms in various ways. In places where the water supplies are pure and the disposal of refuse efficient, the typhoid "carrier" is harmless so long as he is not engaged immediately in the collection, distribution and preparation of certain foods.

(2) By killing them immediately before they attack, so to speak, as by boiling and cooking infected drink and food, and, generally, by the use of aseptic measures.

(3) By killing their insect or animal hosts, such as the louse in typhus, and the rat or flea in plague.

(4) By rendering ourselves immune to their attack. This is what is done in the case of vaccination and immunization, active or passive.

Of these four methods, three of which are of comparatively recent invention, I think that we shall agree that the fourth or last is the most efficacious. The other three are liable to break down. The immunization of the individual is one of the oldest methods of defence against infection, for in the form of inoculation with small-pox virus it has been practised for very many centuries in the East.

The latest form of immunization to be invented is the passive, by the injection of an antiserum of an immunized animal. This has its disadvantages in the shortness of the period of immunity produced, and the frequent occurrence of serum sickness and occasionally of supersensitization. This method has been used chiefly as a prophylaxis against diphtheria. More recently, in the case of measles, human blood-serum has been tried. This has the advantage of not producing serum-sickness or supersensitization. But it gives a temporary immunity only. Still, in the case of young children exposed to measles infection a temporary immunity is of great value; for the longer an attack of measles can be postponed the less likely, under proper treatment, is the patient to die. The disease is most fatal in very young children. There is evidence to show that the earlier in the incubation period the serum is injected, the more likely is the patient not to develop measles. If injected late in the incubation period, the less likely is he to escape an attack; but the attack is most likely to be very mild. So that it has been advised not to inject the serum till after a week from exposure to infection, in order that the patient may have an attack which, though mild, will confer on him a permanent immunity. It has further been suggested that the injection of the immune serum should be followed in a few hours by the injection of some serum obtained from a patient who is in the acute stage of an attack of measles. The serum contains the virus and a permanent active immunity is said to be produced; or I ought, perhaps, to say that it is hoped that such an immunity will be produced.

These methods have been tried in a large number of cases of measles in America, Germany and France, and, it is reported, with considerable success. I know of no such cases in this country. The trouble is the difficulty in obtaining the immune serum. Small doses only are required for young children. The serum from 300 donors is sufficient to immunize from 2,000 to 3,000 children.[1] Possibly in the future some larger animal will be immunized and used as a source for the serum.

As regards the immunization against diphtheria and scarlet fever, of which Sir John Robertson has given us some account, it will be noticed that the bacteriologist has now furnished us with a means for separating the immune from the susceptible person, and that is a gain. Probably, as Sir John says of small-pox, few if any persons are insusceptible to measles. But with diphtheria and scarlet fever the case is different. With increasing age immunity increases. Hence it is not necessary to immunize every person, but only those whom the Schick or the Dick test shows to be susceptible.

The tests as to immunity made at the North-Western Hospital confirm those reported by other observers both as regards diphtheria and scarlet fever. I have no experience of the immunization against scarlet fever, but I have of diphtheria, and I give the following details.

Since April 29, 1924, all nurses have been Schick tested on joining the hospital, and those who have been found to be positive have been urged to be immunized; but immunization has not been compulsory. The return is made up to February 3, 1926.

[1] See a paper by Dr. W. S. C. Copeman in *Journ. Hyg.*, xxiv, December 17, 1925, Nos. 3-4

155 nurses have been tested; of these, 71 (45·8 per cent.) were positive and 84 (51·2 per cent.) were negative. Of the negative reactors none have contracted diphtheria. Of the 71 positive reactors:—

26 have been immunized,
19 have not completed immunization,
19 left before completing immunization,
4 declined to be immunized,
3 contracted diphtheria.

71

Of the three who contracted diphtheria, one had had only a preliminary dose of 0·1 c.c. of toxin-antitoxin mixture; one had full immunization but declined to be re-Schicked; immediately after developing diphtheria she was re-Schicked and was found to be positive. She had obviously not been sufficiently immunized; one had not been immunized at all.

During the period January 1, 1923 to April 28, 1924 (sixteen months), immediately before immunization, seventeen nurses contracted diphtheria.

During a period of twenty-one months (April 29, 1924, to February 3, 1926) during which immunization was carried out, four nurses contracted diphtheria. Of these four, two had not been immunized and one had been imperfectly immunized. They had all been Schick-positive. The fourth was a nurse who developed diphtheria before being Schick tested, and is therefore not included in the seventy-one cases given above.

During the first period, two members of the female domestic staff contracted diphtheria, and during the second period, four. The members of this department of the staff were neither Schick tested nor immunized.

Through the kindness of Dr. Scrase, the Medical Officer of Health of Hampstead, I am enabled to refer to the experience of immunization in a certain institute for girls. Diphtheria was persistently occurring in this institute, and in 1923 it was determined to immunize the girls. The Schick test was applied to 142 of the inmates of the institution, with the result that 86 were found to be positive and 56 negative. All the positive reactors were immunized in the usual way, and since that measure was carried out not a single case of diphtheria has occurred. In Dr. Scrase's opinion the method has proved unquestionably effective in this case.

These examples go to show that in small communities, at any rate, the immunization against diphtheria can be effectively carried out and is of great value.

A note of warning, however, should be sounded against promising too much as the result of immunization against diphtheria and scarlet fever. Let us not forget Jenner and his disciples, who promised a complete and permanent protection as the result of one vaccination. Many years must elapse before we can be certain as to the duration of the immunity induced by inoculation against diphtheria and scarlet fever. But even if it should prove that the immunity dies away in 15 or 20 years, to have produced an immunity lasting through childhood will lead to a large saving of life, for these diseases claim the large majority of their victims during childhood.

Now as regards the four methods of protecting ourselves against the attacks of micro-organisms which I have just enumerated, it will be observed that in the first three we do not touch the individual we desire to protect. We deal not with the individual, but with the herd, and the individuals composing the herd may be quite unaware of our action. We purify a water supply, we destroy rats wholesale, we prevent overcrowding and supply means for personal cleansing, and in so doing we do not interfere with the individual. But in applying the methods of immunization we deal with individuals, and, in this country, that is where the trouble begins. Forty-one years ago Dr. Hilton Fagge wrote that the true method of combating infection seems to be that of which we have an illustration in the practice of vaccination. With that view we have more reason for agreement than had Dr. Fagge himself. But he was over-sanguine, so far as this country is concerned, when he went on to say that there was reason to hope that in the future that method

might be more widely extended than hitherto. Vaccination against small-pox is falling largely into abeyance, and the hope of introducing immunization of the individual on a large scale against other diseases is not very bright. I am bound to say that I have much sympathy with those it is proposed to immunize. Take, for instance, the staff of a fever hospital. They must be vaccinated against small-pox, and it is desirable to immunize them against diphtheria and enteric fever. I have more than once heard complaints at having to undergo so many immunizations; for, as you know, the process has to be repeated two or three times against diphtheria and enteric fever. I have no experience of what it must be in the East, where it may be desirable to immunize against other infections, such as plague, cholera and dysentery, in addition to small-pox and typhoid fever. As regards the population of this country generally at the present time in respect of those diseases prevalent here, against which immunization has been proved to be successful, namely, small-pox, scarlet fever, and diphtheria (I leave out of account influenza and infectious coryza, as its being doubtfully of use in their instance), it is not necessary to inoculate against enteric fever, as the disease is comparatively rare at present. Nor, supposing that inoculation against scarlet fever is proved to be successful, is it, in my opinion, necessary at present to include that disease, for in its severity it is a shadow of what it was. Should immunization against measles and whooping-cough be set on a firm foundation, it would certainly be desirable to employ it. There would then be four diseases to be dealt with by immunization, and the best method of applying it would be a nice problem for the administrator to solve in a country where the public safety is, for political reasons, subordinated to individual freedom. But perhaps some bacteriologist will arise, like a second Mithridates, to invent a theriac by one injection of which immunity against all the infections may be conveniently induced.

Dr. R. A. O'Brien.

In my contribution to this discussion I propose to consider mainly diphtheria and scarlet fever.

Attention has repeatedly been drawn to the fact that after the introduction of diphtheria antitoxin, about the year 1894-1895, a considerable drop in the mortality from diphtheria occurred, but that for many years past the incidence has remained fairly steady.

Can the Schick test and active immunization help in reducing this incidence? Table I records the figures for New York City and Chicago, where testing and immunization have been carried out on a large scale, with the help of a large number of public bodies, private societies interested in public health, and insurance companies.

Table I.—Diphtheria Incidence, New York City and Chicago.

	Year	Number of new cases reported	Number of deaths	Number of persons Schick tested	Number of persons immunized by T.A.T.
(*a*) New York City	1919	14,014	1,239 [1]	12,000	5,150
,,	1920	14,166	1,045	20,000	8,000 (estimate)
,,	1921	15,110	891	140,560	42,000
,,	1922	10,427	873	146,840	48,496
,,	1923	8,050	553	119,493	42,818
,,	1924	9,687	714	130,493	58,936
,,	1925	9,051	663	83,854	38,191
(*b*) Chicago	1922	7,367	564 [2]	5,413	8,396
,,	1923	5,836	366	18,470	28,378
,,	1924	3,672	216	23,296	38,276
,,	1925	2,926	239	21,579	45,282

[1] Average previous ten years 1,337.

[2] Average previous ten years 797.

"In twenty-three representative American cities the death-rate since 1918 has fallen an average of 10·3 per cent. per year. This fall in the twenty-three cities studied by the Statistical Bureau of the Metropolitan Life Insurance Company has coincided with the general application of toxin-antitoxin immunization by city departments of health."[1]

The evidence that these measures have not merely been followed by the drop, but have been the main cause of the drop, though it may not even yet satisfy the rigid requirements of the statistician, will, I think, convince any ordinary observer who has followed the campaign throughout its history.

What Evidence is Available in England?

For the past four years we have been in close touch with three institutions in which diphtheria had occurred, and in which testing and active immunization were begun by ourselves and have been carried out for a period of years. During that time there has been no case of undoubted clinical diphtheria amongst any of the children who have been tested and found negative to the Schick test, either naturally or after immunization. It is true that there are no adequate statistical controls; the only evidence that these measures of testing and immunization have caused the drop in incidence is that no infections have occurred amongst the children living in these residential schools but attending outside day schools, whereas amongst the other unprotected children attending these day schools many cases of diphtheria have occurred.

If the practice of Schick testing and active immunization, efficiently applied, is to be justified in the general community, these processes should be able to control diphtheria in a group of people exposed constantly, and in high degree, to the risk of infection; such groups are represented by the nurses in the diphtheria wards of infectious hospitals.

Incidence of Diphtheria amongst Nurses in Diphtheria Wards.

In 1913, in the hospitals of the Metropolitan Asylums Board, there were 5,475 patients with an attack of diphtheria admitted and fifty-one cases amongst the staff, i.e., one staff case for 107 admissions. The corresponding figures for 1914 were 6,591, 108, i.e., one case for sixty-six admissions. Figures kindly supplied by the Clerk to the Board show that there have been somewhat over 280 "staff" cases of diphtheria in the last three years in which the total admissions were 25,000, i.e., one staff case per ninety admissions.

The Medical Officers of Health of a number of the large cities of England have kindly supplied me with a considerable number of figures. In five cities one nurse became infected with diphtheria for between fifty and 100 admissions, in four cities one nurse for between 100 and 150 admissions, in two cities one nurse for between 150 and 240 admissions. I have therefore assumed that one nurse (or member of the ward staff) catches diphtheria for each 100 admissions. The total number of cases of diphtheria during the past four years in England has averaged 50,000 a year; probably annually 500 nurses in diphtheria wards have suffered from diphtheria. From the information placed at my disposal by the medical officers of the above-mentioned cities, we find that in one city fever hospital testing and immunization are, since a very recent date, obligatory on admission, in nine cities these measures are not used, in two they are offered but little used, in six they have been offered and generally used, in one since 1924, in the others since July last, or at a later date; one hospital reports that the measures were used (apparently for a short period), were "unsatisfactory," and were dropped.

[1] "A Campaign Handbook for Local Tuberculosis and Public Health Associations," State Committee on Tuberculosis and Public Health, New York City, No. 176, 1926, p. 18.

Is it possible or practicable to control the incidence of diphtheria amongst nurses? In three fever hospitals in Great Britain, thorough testing and immunization have been in use during the past few years. Sir John Robertson has told us that in Birmingham from 1916 to 1922 an average of eighteen cases occurred each year amongst the staff; that since active immunization had been applied by Dr. E. H. R. Harries the incidence has dropped and is now non-existent amongst nurses tested and found to be negative to the Schick test. Dr. Kinloch, of Aberdeen, and Dr. Benson, of Edinburgh, very kindly have permitted me to publish the following figures, indicating a large drop in incidence immediately following the use of testing and immunization.

TABLE II.—DIPHTHERIA INCIDENCE AMONGST NURSING STAFFS, EDINBURGH AND ABERDEEN.

	Year	Total nursing staff	Total diphtheria admissions to hospital	Diphtheria in staff	
(*a*) Edinburgh ...	1919 ...	—	—	17	
,, ...	1920 ...	148	1,201	10	
,, ...	1921 ...	146	1,111	14	
,, ...	1922 ...	147	914	13	(September, 1922)
,, ...	1923 ...	137	854	5[1]	
,, ...	1924 ...	128	821	4[1]	
,, ...	1925 ...	161	1,050?	4[1]	

[1] All in Schick positive nurses shortly after admission or before immunization.

(*b*) Aberdeen ...	1912 ...	125	—	6	
,, ...	1913 ...	125	—	15	
,, ...	1914 ...	125	—	15	
,, ...	1915 ...	125	—	8	
,, ...	1916 ...	125	—	10	
,, ...	1917 ...	125	—	10	
,, ...	1918 ...	125	—	7	
,, ...	1919 ...	125	—	5	
,, ...	1920 ...	125	—	18	
,, ...	1921 ...	125	—	18	
,, ...	1922 ...	125	—	2	January, 1922[2]
,, ...	1923 ...	125	—	0	
,, ...	1924 ...	125	—	3	
,, ...	1925 ...	125	—	1	

[2] Active immunization commenced.

With regard to "reactions," local or general, amongst the nurses after testing and immunization where these measures are in operation, the general reports are "reactions negligible" and "no nurse off duty," or that, at the worst, they cause no administrative difficulty.

It would appear, now that it is practicable greatly to reduce or to abolish diphtheria among nurses, that serious consideration throughout large fever hospitals in England should be given as to the advisability of attempting to prevent the occurrence of the annual 500 cases of diphtheria amongst nurses in fever hospitals. If diphtheria could be abolished a considerable amount of dislocation of hospital routine, time and money would be saved, to say nothing of the personal inconvenience and risk to which the affected nurses are subjected.

SCARLET FEVER.

Incidence.—In 1913 in the Metropolitan Asylums Board hospitals 117 cases of scarlet fever occurred amongst the staff, 15,010 cases were admitted, i.e., one staff case per 130 admissions; for 1914 the figures were 236, 22,000 = 1 per 93. The figures for two large cities from 1920-5 were 1 per 160 and 220. I have therefore assumed that one staff infection occurs for each 200 scarlet fever patients admitted. The average notification for the past four years in Britain has been 103,000; presumably 500 cases occurred amongst ward staffs. In the scarlet fever wards of one hospital, amongst 429 nurses employed during nine years forty-seven caught scarlet fever, i.e., 9 per cent.

From our very meagre English experience we cannot yet say that Dick testing and active immunization have proved their ability to abolish scarlet fever from the ward staffs, but American experience seems to enable one to predict with some confidence that these measures will be successful in greatly diminishing or abolishing the occurrence of scarlet fever.

Though a negative response to the Dick test as at present carried out does not apparently indicate the practically complete immunity to scarlet fever that a negative response to the Schick test does in connexion with diphtheria, it is reasonable to conclude on the evidence available that a negative Dick response does indicate a considerable degree of protection. Thus, in one hospital in Great Britain in a certain period fourteen children were admitted as certified scarlet fever, but were, in the opinion of the admitting officer, not, or probably not, suffering from scarlet fever. It was necessary to send them all to the same wards; eight of the children were positive to the Dick test; of these six developed scarlet fever in the hospital; of the six children with Dick negative response none developed scarlet fever.

Dr. Mussen kindly gave me the following figures relating to Fazakerley: During a certain period Dr. Rundle records that of forty-four nursing entrants who had suffered before entry from scarlet fever none developed the disease during their hospital career; of 108 with no previous history eleven contracted the disease and one died; of another group of thirty-three with no previous history of infection five became infected with the disease. Since July, 1925, forty nurses have been immunized with Dick toxin; up to the present no cases of scarlet fever have occurred amongst them.

Conclusions.

(1) Probably 500 cases of diphtheria and 500 of scarlet fever occur annually in England amongst nursing and ward staffs of infectious fever hospitals.

(2) Where Schick testing and active immunization have been adequately carried out the incidence of diphtheria amongst the staff has dropped practically to nothing.

(3) There is ground for hoping that similar testing and immunization will greatly reduce or abolish scarlet fever from amongst hospital staffs.

Major G. S. Parkinson, R.A.M.C.

said that unfortunately Sir Wilfred Beveridge was unable to be present to take part in the discussion, and that he (Major Parkinson) had been asked at short notice to take his place and say a few words as regards the control of infectious disease under active service conditions.

With regard to infectious disease in time of war, it must be remembered that one was dealing with a disciplined population. This to some extent simplified procedure, but, on the other hand, one had to conform to the requirements of the military situation, which sometimes counteracted this advantage.

Enteric fever, which had proved so disastrous in the South African war, did not prove a serious menace on the Western Front, thanks to preventive inoculation.

He said that in the late war the campaign was one of stasis, and that in future campaigns, under possibly more mobile conditions, protective inoculation might be called upon to play an even more important part in the prevention of disease.

Sanitary sections rendered valuable services in maintaining the health of the troops. Their work consisted in the control of water supplies, supervising the safe disposal of excretal matter, waging war on flies, marking and disinfecting infected billets, preparing spot maps of infectious disease, and obtaining information as to the health of the civil population.

In the early days of the War there was a tendency to pay too much attention to the isolation of contacts, however remote, but, as time went on, the direct contact was the only one that came under supervision.

With regard to diphtheria and cerebro-spinal fever, he had little faith in the various medicated sprays; better results were obtained by free ventilation and "spacing out," and the same methods were now adopted in barracks when influenza was prevalent.

In his introductory address Sir John Robertson said that "recent efficient vaccination is about as absolutely a certain method of prevention as anything we know in the whole art of medicine." Gibraltar provided a very good illustration of this latter statement; here one seldom met with a case of small-pox contracted in the city, though there was daily intercourse between Spain and the coast of Morocco, where this disease was endemic. The explanation of this was that vaccination was compulsory in Gibraltar at birth as well as at the twelfth year.

Dr. E. L. Sturdee, O.B.E.

It is always difficult to know for certain the value of our administrative control of infectious diseases because of our lack of knowledge of what it is that causes increased severity of certain diseases, and of what produces periodic increased incidence, amounting to a pandemic of the disease. For instance, a man looking at the figures for the death-rate of influenza in the year 1919, might have thought that we had got the better of this disease, whereas the mortality from influenza in 1918 would have come as a shock to him.

The administrative control of plague and cholera which, of necessity, takes place at ports in this country, is covered by the Local Government Board's Cholera, Plague and Yellow Fever Order, 1907. Curiously enough, the first person to have to deal with a case of any one of these three diseases is not, as a general rule, the medical officer of health, but the officer of Customs, who first boards the vessel and whose duty it is to inform the medical officer of health of the presence of a case of plague or cholera on board, or rather of an illness which may turn out be one of these diseases. So far, as Sir John Robertson mentions, we have been successful in preventing the spread of plague or cholera in this country, but it must be remembered that neither disease has of recent years been present in epidemic proportions in any adjacent European country.

Typhus fever is another disease of which it is difficult to be certain that it may not attain epidemic proportions at some time or another. Personally, I am rather of the opinion that typhus is probably endemic in a mild form in certain districts in England. Some years ago I was asked to see a man in one of the home counties, who appeared to me, and to other medical men who saw him, to be suffering from a fairly mild attack of typhus, from which he recovered. He apparently infected his wife who had similar symptoms, but also recovered. The source of infection, if they did have typhus, was not traced with any certainty and it is only fair to say that, so far as I can recollect, the Weil-Felix reaction was done some time later and found to be negative. The year before last there was a small outbreak of typhus in a Lancashire town with a large proportion of deaths. The patients were Irish, and dirty; it was therefore supposed that the infection came from Ireland, but it was not proved; and when it is remembered that during the outbreak itself such different diagnoses were made as pneumonia, influenza, enteric fever, and malignant measles, the possibility of previous overlooked cases having occurred cannot be disregarded. Similarly, two or three years ago another small outbreak of typhus occurred in a Cheshire town, and here, too, the first cases were diagnosed as influenza. Such errors in diagnosis make it appear possible that overlooked cases of typhus are occurring in more districts than one in this country, and should the incidence and severity become increased at any time for reasons of which we have no certain knowledge, typhus might become epidemic once more as it was so frequently in the past.

Diphtheria, too, the mortality of which as Sir John Robertson has pointed out, has decreased greatly of recent years, still causes local outbreaks, here and there, accompanied by a high mortality. In the early part of this winter I investigated an outbreak of this kind which caused a good deal of local panic. There seemed to be some reason for believing that earlier diagnosis and prompt administration of adequate doses of antitoxin would have lessened the mortality and possibly have limited the outbreak.

The point which I want to make is that, primarily, the prevention of high mortality in infectious diseases and possibly also of a large incidence, rests not with the public health authorities, but with the medical attendant of the patients, who, by early diagnosis and by prompt administration of appropriate treatment, helps to render effective the administrative measures of the medical officer of health.

Sir John Robertson's remarks on the value of infectious diseases hospitals at the present time strike a happy mean between those extremists who consider that such institutions are of no value whatever, and those who believe that every case of infectious disease should immediately be isolated in hospital. Infectious diseases hospitals at least provide a bed and expert treatment for those who cannot afford them in their own homes.

Section of Medicine.

President—Dr. HUGH THURSFIELD.

DISCUSSION ON THE CLINICAL SIGNIFICANCE OF THE RESPIRATORY METABOLIC RATE.

Dr. E. P. POULTON.

(ABSTRACT.)

THIS discussion on the clinical significance of the respiratory metabolism will probably be chiefly confined to the so-called basal metabolic rate, i.e., the absorption of oxygen and output of carbon dioxide (respiratory exchange) measured in the morning before breakfast some twelve hours after a light meal taken the evening before. But the discussion is meant to cover a larger field so as to give an opportunity for observers to bring forward results on the changes in respiratory exchange after food or after exercise. There has already taken place this session a very full discussion on exophthalmic goitre,[1] the disease which has given rise to most of the work on the basal metabolic rate in recent years. Consequently it may be expected that the present discussion will be carried on chiefly by those who have themselves had actual experience in the technique of the determinations, and the examination of technique may well form part of the discussion.

TECHNIQUE.

Direct calorimetry is not used as a clinical method. The methods for indirect calorimetry may be divided into (*a*) *the open circuit method*, where air from the atmosphere is breathed through mask and valves and the expired air collected. In this country the Douglas bag is usually employed and the expiratory volume measured by being passed through a gas meter. The method is shortened if a spirometer is used instead of a bag, since the volume of air is measured as it is being collected. The analysis of samples of expired air, for both carbon dioxide and oxygen, is a time-consuming business, but as shown by some observations carried out by Debenham and myself, fairly close agreement of duplicate determinations is often obtained. It must be remembered that the calculation of the absorbed oxygen is complicated by the alteration in volume that the inspired air undergoes during breathing—as pointed out by Haldane. The open circuit method has been used for determining the carbon dioxide alone. Hardly anybody, I think, would follow King, who actually weighs it. The easiest method is to get the patient to breathe directly

TABLE 1.—RESPIRATORY EXCHANGE.

Case	CO_2 c.c. per min.		O_2 c.c. per min.		Difference
A	155	A	229		
	136		214	...	15
B	158	B	211		
	158		215	...	4
C	195	C	259		
	176		251	...	8
E	218	E	243		
	213		251	...	8
F	186	F	236		
	186		219	...	17
H	218	H	274		
	207		262	...	12
I	199	I	228		
	181		254	...	26
J	163	J	193		
	156		191	...	2

[1] *Proceedings*, 1926, xix (Sect. Surg., Med., Electr.-Therap., Therap.), pp. 101-132.

through first a bottle and then a meter with a bag interposed between the two and to take samples from the bottle at intervals.

I think everyone must admit that to measure either oxygen or carbon dioxide alone is a *second best* method, because the double determination provides a valuable check upon one's results and the respiratory quotient can be calculated as well.

(*b*) *Closed Circuit Method.*—This is the favourite method where the oxygen alone is determined. A spirometer is filled with pure oxygen; the carbon dioxide is absorbed in the circuit, and the rate of fall of the spirometer indicates the volume of oxygen absorbed. In Benedict's universal and in his portable apparatus the output of carbon dioxide is obtained by weighing; but this is a fairly lengthy undertaking. Kipping's apparatus is a closed circuit, and after the experiment the absorbed CO_2 is liberated by acid and collected in the same spirometer as contained the oxygen used during the experiment.

Dr. Campbell and I have attempted to combine various principles described by other observers into one new type of apparatus, which will be on view. We claim: (1) That the results for oxygen and carbon dioxide are obtained during the actual experiment, so that it is possible to be quite certain how constant the metabolism is from 5 mins. to 5 mins., and there is no waste of time with subsequent analysis. (2) The patient is breathing ordinary air, therefore a preliminary period in which saturation of the tissues with pure oxygen is taking place—as in the Benedict or Krogh's apparatus—is not required. (3) The experiment can be prolonged indefinitely, provided the source of the oxygen is pure. Cylinders often contain too high a percentage of nitrogen, and this must be remembered. The apparatus may be washed through with some oxygen beforehand. Haldane and Douglas advise oxylith. (4) A volumetric tracing of the respiration may be obtained, if it is required.

It may be said that two standards are in general use to obtain the normal figures for any individual. There is the method of calculating the normal metabolism from the body surface, which is obtained from the weight of the individual and his height from the Dubois diagram or a corresponding nomogram. There is Dreyer's formula in which the body weight appears but not the height. So far as one can make out from the description of many observers the body weight of the patient is taken at the time of the experiment, notwithstanding the fact that he may be wasted from disease or over-fat. In the former case the metabolism is lower than it would be supposing that it had been calculated, using the normal weight of the patient before the disease began. This seems to be wrong, since the patient should be regarded as a physiological unit; but it might be defended in the case of wasted patients from the point of view that the wasting of the disease had diminished the protoplasm of the individual or the surface, and so had diminished the metabolism. To see whether there is any value in this suggestion, I have compared the actual metabolism of Benedict's starving man at the beginning of his fast, during four days in the middle of his fast, and during the last four days of his fast with the values that would have

TABLE II.—RESPIRATORY EXCHANGE OF SUBJECT L.

	Weight			Calories per 24 hours		
	kg.	lb.		Actual	Dreyer	Dubois
Before fast ...	60·6	133·5		1554	1475	1600
			18	335	105	90
Middle of fast ...	52·5	115·5		1219	1370	1510
			10	97	170	50
End of fast ...	47·9	105·5		1122	1200	1460

Average of four days taken.

been obtained from Dreyer's formula and the height-weight formula of Dubois. It will be noticed that there is no correspondence between these results, and consequently the weight of the individual when he was healthy, or the predicted weight, should always be used in calculating the metabolism. The only method of predicting the body weight at present is from tables giving Ainley Walker's figures for the body length and Dreyer and Hansen's chest measurements and the corresponding body weights in healthy individuals. Unfortunately the chest measurement is practically of no value when the patient is much wasted or over-fat. Consequently we must fall back upon the body length of the individual to determine what his weight should be, unless he knows himself what it was previously. It would certainly be valuable to have other factors, such as the length of the arms and the legs, from which a more certain value for the predicted weight could be obtained.

Clinical Significance.

The variations in basal metabolism in thyroid disease were first of all worked out by Magnus-Lévy, and it is worth while pointing out that this worker established, some twenty years ago, nearly all our present knowledge on the subject of basal metabolism. The clinical significance in thyroid disease may be regarded from two points of view: (1) diagnostic; (2) as indicating the effect of treatment.

On the one hand we have the well-established fact that in hyperthyroidism the basal metabolism is raised, while in cretinism, myxœdema, and the post-operative disease, basal metabolism is lowered. But in using the basal metabolism as a method of diagnosis it must be remembered that certain other conditions, i.e., fever and leukæmia, cause a raised metabolism, whilst starvation, underfeeding and Addison's disease cause a lowered metabolism. A basal metabolism observation may be of value in excluding a hyperthyroidism as a cause of wasting which may have suggested itself as a possibility to the doctor. However, there are certain patients who have well-marked signs of Graves' disease and yet give a normal metabolism. Means calls these border-line cases. In one of my patients the metabolism had been raised about a year previously, but at the present time is normal and certain symptoms still remain. Presumably these are the relics of a previous activity of the gland. As a guide to treatment the basal metabolism is of very great value, not only in cases of exophthalmic goitre but also in determining the right dose of thyroid to give in cretinism and myxœdema.

The observations by various authors on fever are of great interest from the pathological, if not from the clinical, point of view.

It is worth while saying a little on the subject of obesity, because it is probable that in the future respiratory tests will be used more frequently in the treatment of these conditions. Means has found that the basal metabolism per unit of body surface in obesity is about normal, but this re-opens the discussion of the point already alluded to as to the correct standard of comparison in such cases. If the metabolism of the healthy subject before he became fat is used as a standard, then the basal metabolism of obesity is usually abnormally high, a surprising fact considering that adipose tissue by itself probably has a very low respiratory exchange and that the fatty tissue surrounding the patient also tends to prevent the loss of heat, in spite of some increase in the body surface. An increased metabolism of this kind might be explained as due to an increased intake of food, on the analogy that fasting produces a lowered metabolism; and this theory would certainly be compatible with over-eating and under-exercise being the main cause, rather than some endocrine disturbance that lowers the power of combustion which the body normally possesses. However, some observations by Plaut make it possible that in these cases it is not so much the basal metabolism that is at fault, as the so-called specific dynamic action after the intake of food. She claims that after a protein meal is consumed the rise in the respiratory exchange is less than normal.

I should also like to refer to some observations by Campbell and myself on the effect of exercise on the respiratory exchange of a patient with severe bronchitis and asthma. We found that the respiratory quotient as the result of exercise was lower than was the case among normal subjects, while the total oxygen intake remained the same; yet treatment with oxygen caused a rise in the quotient to about the normal value. We think there may be some qualitative alteration in the metabolism due to exercise in the patients, who are suffering from chronic oxygen want. Hetzel and Long have found low quotients for exercise in diabetics.

Dr. H. Gardiner-Hill.

I will give a brief account of our results in the Medical Unit at St. Thomas's Hospital with the open circuit method of determining the respiratory metabolic rate. During the last five years we have used this method entirely, and followed the technique laid down by Haldane and Douglas. Air from the atmosphere is breathed through mouthpiece and valve, and the expired air collected in a Douglas bag. Subsequent analyses were made in the Haldane gas analysis apparatus.

When we first began making determinations of the basal metabolic rate, we also gave a trial to the closed circuit method, using the Benedict apparatus, but as a result of a number of duplicate experiments with the two methods, we came to the conclusion that more consistent results could be obtained with the Haldane-Douglas bag. There is the additional advantage in this method that it is not necessary to take the patient from familiar surroundings. The expired air can, if necessary, be collected in the patient's home. It also affords more nearly normal conditions as regards the air breathed, and the tubes and apparatus can be more readily cleaned, so that the patient is not so liable to be exposed to infection. This objection, I know, has been frequently over-ruled, but personally I would prefer to breathe through tubes which were kept for purely inspiratory purposes rather than into a closed circuit apparatus.

In the calculation of our results we have employed the Dubois method and used the Dubois height-weight chart for obtaining the body surface. In the case of our ordinary routine examinations, the basal metabolism has been worked out on the observed weight at the time of experiment.

Clinical Significance.

We have made between three and four thousand determinations of the basal metabolism during the last five years in various endocrine disturbances and other cases, and, as a result of this experience, we have come to the conclusion that basal metabolic investigations *per se* are of little clinical value, except in the case of thyroid disturbance. Here they have proved of unquestioned value, especially in doubtful cases. I will discuss this more fully later, and refer to certain groups of patients in whom a low basal metabolic rate has suggested a subthyroidic factor, and who have subsequently benefited from thyroid treatment. But it has seemed to us that in so far as the ductless glands are concerned with basal metabolism, the thyroid plays by far the most prominent part, and practically dominates the whole picture. At least, that is how we have interpreted our results.

I will first, however, mention some results of basal metabolic investigations in other than thyroid cases.

In gross cases of pituitary disturbance, apart from cases of pituitary obesity, there does not appear to be any very definite alteration of the basal metabolism. In five cases of pituitary tumour without glandular signs, the basal metabolism was within the normal limits in four, and −22 per cent. below in the other. In six cases of acromegaly the basal metabolism was within the normal limits in two, slightly above the normal limits in two (+ 20 per cent.), and slightly below the normal limits in the other patients, one of whom had a large goitre. In cases of adolescent obesity of the pituitary

type, the basal metabolism on the whole does tend to be below the normal levels, especially in the cases of long duration. In a series of twenty-eight previously untreated cases, the basal metabolism was within the normal limits in one-third, and below the normal limits in two-thirds, and of the latter the majority were below −20 per cent. But these calculations were made on the weight at the time of experiment rather than on the predicted weight. If the latter method had been used, the results would not have been so low. One cannot, however, entirely eliminate the subthyroidic factor in these patients. Dott and others have shown that after partial removal of the anterior lobe of the pituitary in animals, changes of a degenerative nature occur later in the thyroid gland. Many of the cases mentioned had features suggestive of subthyroidism, and it seems possible that the subnormal metabolism might be explained on the basis of a secondary thyroid deficiency. This possibility is further suggested by the large doses of thyroid extract which these patients are able to tolerate.

In cases of adrenal disturbance, we have not found any consistent alteration of the basal metabolism. In the cases of Addison's disease examined, the metabolism has been within the normal limits. In other patients, minor forms of virilism, where there has been some reason to suppose an alteration of function of the adrenal cortex, the basal metabolic results have either been within the normal limits or just above them. In two patients, readings of + 17 and + 20 per cent. were found, but in both cases there was present, in addition to the symptoms of adrenal disturbance, a very definite goitre.

In cases of disturbance of the genital glands also, there appears to be seldom any definite alteration of basal metabolism. In the cases of male eunuchoidism examined, it has been within the normal limits, though in several cases of undeveloped females of the eunuchoid type, basal metabolic results considerably below the normal have been recorded. In a series of fourteen cases of amenorrhœa, however, without any particular endocrine stigmata, the basal metabolic results were all within the limits of ± 15 per cent. Two male castrates investigated gave results of + 8 per cent. and − 8 per cent. respectively, but of a series of twelve female castrates, five, all of whom had had the operation of double ovariotomy performed for "floodings" which subsequently proved to be the first symptom of myxœdema, gave basal metabolic readings between −16 and −35 per cent. Two cases of pubertas præcox were found to have a basal metabolism within the normal limits.

In addition, I would like to mention the normal figures obtained in two cases of lipodystrophy and two cases of mongolism.

Determinations of the basal metabolism, however, have proved of considerable practical utility in thyroid disturbance, both in diagnosis and in following the effect of treatment. The question of the basal metabolism in Graves' disease and hyperthyroidism has been recently fully discussed before this Society, and I have nothing to add to what has already been said. We have found the same consistent fall in basal metabolism after the administration of Lugol's iodine in cases of true exophthalmic goitre, and the same relapse when this treatment is discontinued. Basal metabolism determinations have been of great value in the diagnosis of minor degrees of hyperthyroidism, and in indicating or excluding a hyperthyroid factor in cases of loss of weight, nervousness or tachycardia. They would also appear to give some indication of the amount of thyroid to be removed in patients with simple or multiple adenomata. I can recollect three such cases, in whom myxœdema developed as a result of hemithyroidectomy, the basal metabolism just previous to operation being on the lower limits of the normal.

In the diagnosis of early or latent cases of myxœdema and hypothyroidism, we have obtained considerable help from estimations of the basal metabolism, and particularly in the differential diagnosis from other forms of œdema.

There would also appear to be a group of cases of menorrhagia occurring in later life and without obvious local cause, in whom estimations of the basal metabolism

might unmask a tendency to subthyroidism. We have not only seen menorrhagia result from subthyroidism following hemithyroidectomy, but I have already mentioned five patients, in whom the operation of double ovariotomy was performed for "floodings," who very shortly afterwards were found to have developed myxœdema, with abnormally low metabolic rates. From our experience it would appear that when myxœdema or subthyroidism develops before the menopause, menorrhagia is a frequent accompaniment. On the other hand, in our series of cases of myxœdema, the majority have only developed after the natural menopause.

I will refer briefly to the question of menstruation in hyperthyroidism. It is sometimes stated that menorrhagia is a frequent accompaniment of this condition, but it has not been so in our experience. We have investigated this question in two groups of cases:—

(1) A series of forty-four cases of exophthalmic goitre seen in the years 1922 to 1923 at St. Thomas's Hospital. In these cases the basal metabolic rate varied between + 75 per cent. and + 30 per cent. They were typical cases of exophthalmic goitre. In this series menstruation was normal in 32 per cent. In 66 per cent. there were either definite periods of amenorrhœa or menstruation was delayed, irregular and scanty. In only 2 per cent. was there menorrhagia.

(2) A series of 100 cases of adolescent goitre with varying degrees of functional thyroid disturbance, the extent of which was determined by estimations of the basal metabolic rate. This series of cases has already been published in the *Quarterly Journal of Medicine*, but I would like to draw your attention to the effect of the varying degrees of functional thyroid disturbance upon menstruation. The following table explains itself:—

	Group I Colloid goitres			Group II Exophthalmic goitres
	Subgroup A Normal function	Subgroup B Hyper-function	Subgroup C Hypo-function	
Menstruation not started ...	49 per cent.	14 per cent.	0 per cent.	0 per cent.
Menstruation normal	42 ,,	45 ,,	48 ,,	28 ...
Menorrhagia	3 ,,	0 ,,	48 ,,	0 ...
Delayed, irregular and scanty menstruation	3 ,,	27 ,,	4 ,,	0 ...
Periods of amenorrhœa ...	3 ,,	14 ,,	0 ,,	72 ...

In our own minds there is not much doubt that hyperthyroidism is more frequently associated with amenorrhœa and hypothyroidism with menorrhagia.

Estimations of the basal metabolic rate have also proved of value in certain cases of sterility and repeated miscarriages without local cause. A low basal metabolic rate has suggested a subthyroidic factor. In a series of between twenty and thirty cases, pregnancy is known to have occurred in seven, and pursued a normal course to full term, following the administration of desiccated thyroid extract.

I can only briefly refer to the value of basal metabolic determinations in the diagnosis of thyroid deficiency in certain undergrown and under-developed children, especially in those cases in which the dietetic factor can be excluded. We have also found this method of investigation useful, in children with backwardness or minor mental defect, as a means of determining or excluding a possible thyroid factor.

Dr. C. M. Wilson

said that a discussion of this nature would be justified if it could be shown that these measurements supplied something in diagnosis and treatment which clinical observation alone did not supply. In diagnosis the method was useful in distinguishing a non-toxic goitre in a nervous woman from a toxic goitre causing nervous symptoms. It was also useful in a group of cases, common at neurological hospitals, in which the patients were nervous women with palpitations, some loss of weight, and other

symptoms which might or might not be due to hyperthyroidism. A diagnosis could be made in this group by means of these measurements when clinically such a diagnosis could only be suspected, and it could be made at an early stage of the disease when treatment was likely to be far more effective than if it was postponed until the diagnosis on clinical grounds could be established. There were certain cases also of hypothyroidism, stopping short of myxœdema, which showed a definitely lowered basal metabolic rate, and these cases cleared up with the administration of thyroid extract. In brief, in diagnosis, though the measurements were not necessary for the confirmation of frank exophthalmic goitre or myxœdema, they were very useful in making an early diagnosis before the case was obvious clinically. In treatment the measurement of the basal metabolic rate did not enable one to see whether X-rays or surgery were to be preferred in the management of exophthalmic goitre, but when the choice of treatment had been decided upon it was essential in the control of that treatment. He regarded it as unsafe to treat exophthalmic goitre with X-rays unless the treatment was controlled by the basal metabolic rate, for such methods not only prevented the treatment from being carried too far, but also ensured it was not stopped, through excessive caution, at too early a stage. The measurements did not indicate which were suitable cases for surgery, but they did indicate the right time for surgery, which was one of the three factors in successful operation, the others being the right choice of case and the skill of the surgeon. He believed that if an operation was done on a rising metabolic rate there would be trouble. Altogether these measurements lent precision to prognosis, and with regard to treatment they gave an element of safety which, so far as he knew, other observations could not supply.

Dr. R. D. Lawrence.

I do not share Dr. Wilson's optimism that the basal metabolic rate estimation often gives further information on hyperthyroidism than a careful consideration of the clinical condition. During the last year or two I have adopted the practice of guessing the basal metabolic rate from the clinical condition, particularly from the pulse-rate, and have rarely found that the actual estimation differs more than 5 or at most 10 per cent. from the rate predicted on clinical grounds, except in cases of very high or very low values, where I do not pretend to distinguish by guessing between figures of + 60 and + 90 per cent. In distinguishing between neurotic and mild hyperthyroid conditions the usual figures obtained are from + 5 to + 15 per cent., and give no clear indication of whether the thyroid is primarily to blame. I consider that the laboratory worker is asked to undertake a great number of lengthy estimations that have no more value in diagnosis or prognosis than a careful clinical survey. The greatest advantage of the basal metabolic rate estimation is the numerical record that it affords in experimental therapeutic work.

A study of the *respiratory quotient* shows points of great interest. I have found a low respiratory quotient in many cases (0·71 to 0·75) proportional to the severity of the disease. As the cases improve after medical or surgical treatment, the respiratory quotient rises also, and I look upon it as of considerable prognostic importance. This is one of the chief effects I have noticed in my experimental work in treating Graves' disease with insulin.

Another use to which I have put the estimation of the respiratory exchange is the differentiation of Graves' disease with the usual upset of carbohydrate metabolism—i.e., a raised blood-sugar after the ingestion of glucose or carbohydrate but a normal fasting blood-sugar—from Graves' disease with true diabetes supervening, shown by raised fasting blood-sugars. Besides, by the fasting blood-sugar level, they can be differentiated in the following way. For example, in two such cases the basal metabolic rate is estimated fasting, and we shall suppose that it is + 30 per cent. in both, and the respiratory quotient is 0·74. In the pure Graves' case the

fasting blood-sugar is normal while it is raised in the diabetic. Fifty grams of glucose are then given by mouth, and the respiratory exchanges are again estimated in one or two hours. The blood-sugar curve is raised and prolonged in both cases. In the Graves' case the respiratory quotient will rise to 0·9 or 1 after the glucose, the metabolism to about + 80 or + 120 per cent., the patient feels hot and excitability may be increased—all evidence that glucose is being burned. On the other hand, in the Graves' case with true diabetes, the respiratory quotient will rise only slightly and the metabolism will probably increase very little from + 30 to + 50 per cent.

It is of great practical importance to make this differentiation, because the high feeding, usually particularly rich in carbohydrate, which is advisable in Graves' disease, is the worst possible treatment for the diabetic type and quickly induces a severe diabetes; this I unfortunately allowed to happen in the case of one patient. The fasting blood-sugar is usually enough to differentiate the two conditions, but the above test is confirmatory and in my experience runs parallel with it.

The different physiological processes underlying the two conditions seems to be adequately explained in the light of our knowledge of the respective action of insulin and thyroxin on carbohydrate metabolism. In diabetes, where insulin is deficient, glycogen is neither formed nor stored, and the fasting respiratory quotient is low. And as glycogen seems an essential stage in the proper combustion of carbohydrate, the respiratory quotient fails to become normal even after carbohydrate ingestion. On the other hand, it has been clearly shown that thyroid feeding in animals empties the glycogen stores, and the same condition almost certainly occurs in Graves' disease and explains the disturbance in carbohydrate metabolism. In severe cases, with no glycogen store, the fasting respiratory quotient is low, but rises to normal after carbohydrate is administered. Indeed, the burning of carbohydrate in Graves' disease is excessive and probably the immediate cause of the raised metabolism. It would seem most probable that glycogen formation goes on, but that the excess of thyroxin causes glycogenolysis and the rapid burning of sugar. In the pure Graves' case insulin is probably not defective, but the frequent high blood-sugars caused by the excessive glycogenolysis ultimately overstrain the pancreas cells and produce a condition of true pancreatic diabetes in a certain small proportion of cases.

Dr. R. Hilton

spoke of the wide margin of error in the oxygen absorption method; this was reduced by the use of Douglas's bag, which also gave further information. It was comforting to think that the progress of a disease could be measured numerically, but he rather agreed with Dr. Lawrence that these determinations were more useful in research than in routine general practice. They helped particularly in the treatment of myxœdema, and in deciding whether a second operation was necessary in Graves' disease, but he knew that some surgeons who once used the method regularly could now dispense with it. It was a useful control, but it could only confirm, not replace, the findings of the clinician. Mention was made of basal metabolic rate investigations in patients who were losing weight under artificial pneumothorax.

Dr. Poulton (in his reply)

said that the main value of the discussion was to bring out the large amount of valuable work on this subject that was being carried out in London at the present time. He did not agree with Dr. Lawrence that these determinations in Graves' disease were unnecessary. He would himself be sorry to have to treat a case of Graves' disease without such measurements.

Section of Medicine.

President—Dr. HUGH THURSFIELD.

Pituitary Glycosuria.

By P. J. CAMMIDGE, M.D.Lond.

SINCE the association of glycosuria with acromegaly was described by Lépine in 1891, it has been recognized that the pituitary is connected in some way with carbohydrate metabolism. The effects produced in animals by removing portions of the gland and by injecting extracts made from them, have indicated that its influence is exerted through a secretion formed by the posterior lobe, but the way in which it acts and its functions in normal metabolism are not clear. The discovery of insulin has made it possible to investigate the subject from a new point of view, and I propose to consider the results of experiments Mr. Howard and I have carried out, and then to deal with their clinical application.

In 1921, Langfeldt showed that the addition of adrenalin to the isolated diastatic ferment of the liver, incubated at body temperature in phosphate solutions of different hydrogen-ion concentration, increased glycogen hydrolysis, and that while thyroiodine alone had no influence upon the process, the simultaneous addition of adrenalin and thyroiodine had a very pronounced effect, adrenalin solutions so dilute as to produce no change alone becoming active in the presence of thyroiodine. Other experiments showed that extracts of the anterior and posterior lobes of the pituitary neither promoted nor retarded glycogenolysis.

Similar observations which we subsequently carried out confirmed these findings. Later, we extended them by experimenting with insulin and found that it interfered with the conversion of starch into sugar by liver diastase on the acid side of neutrality in proportion to the concentration employed, but that within the normal blood range and on the alkaline side beyond, the results were practically the same as those given by controls unless parathyroid was also added, when as great an effect was produced as by insulin in a distinctly acid medium, although parathyroid alone was proved to have no influence on starch hydrolysis. Mixtures of insulin and adrenalin gave results depending upon their relative proportions, the net effect being apparently the algebraic sum of their respective influences upon the activity of the diastatic ferment; the same was found to be true when the insulin and adrenalin were activated by parathyroid and thyroiodine respectively. Further experiments showed that pituitrin had the property of checking the activity of insulin, even when the insulin was activated by parathyroid, but as pituitrin itself had no influence upon the activity of the diastatic ferment of the liver, it seemed probable that this effect was a result of a chemical neutralization rather than of an opposition in physiological function, as is the case with adrenalin and insulin.

Evidence in support of this view was obtained by determining the respiratory quotient in rats and guinea-pigs after injections of insulin, adrenalin, and pituitrin separately and together. It was found that insulin and adrenalin both raised the quotient but that pituitrin had no such influence; a mixture of adrenalin and insulin varied in its effect on the same animal according to the proportion of the two in the mixture, an excess of either causing a rise, whereas pituitrin added to insulin prevented the rise which would otherwise have occurred but did not increase the quotient when it was present in excess.

Having ascertained the proportions in which insulin and pituitrin must be mixed before injection in order to have no appreciable influence upon the respiratory quotient, we proceeded to investigate the effects produced by alterations in the reaction of the phosphate solutions with which they were mixed, and found this made a considerable difference: a mixture which proved to be inert when the reaction was neutral or alkaline becoming active and raising the respiratory quotient when it was rendered acid, a solution at pH 4·0, for instance, producing almost as great an increase as the same dose of insulin alone. Further, observations upon the blood-sugar showed that while the injection of an alkaline or neutral mixture of insulin and pituitrin produced no change, the same dose in an acid medium was followed by a fall of 20 to 40 per cent.

It would therefore seem that, although the secretion of the posterior lobe of the pituitary has no direct influence upon the storage or utilization of carbohydrate, it may influence these processes indirectly by the property it possesses of forming a loose chemical complex with the internal secretion of the pancreas at the normal reaction of the blood. It is likely that in a healthy individual this influence is mainly local and is designed to protect the brain and nervous system from the changes which would be caused by glycogen being deposited under the unchecked influence of insulin. This hypothesis is strengthened by observations we have made upon the brains of rabbits which had succumbed to fatal doses of insulin, since they were found to contain an abnormally high percentage of glycogen, the average figure being 1·4 per cent. compared with the normal of 0·047 to 0·29 per cent., suggesting that the local protective influence of the pituitary had been overcome by the massive doses of insulin introduced into the circulation.

The property of inactivating insulin at the normal reaction of the blood, possessed by pituitrin, possibly explains, at least in part, the discordant effects of pituitrin injections upon the sugar-content of the blood and urine in animals described by different observers. If we assume that the percentage of sugar in the fasting-blood is the result of a balance between opposing influences—which include the activities of the internal secretion of the pancreas on the one hand and of the suprarenals on the other,—it is evident that should some substance capable of inactivating one of these secretions be introduced into the circulation a temporary change in the sugar percentage will follow, as a relative excess of the other secretion will then be present. If the inactivating substance is produced within the organism the effect following an injected dose will then be determined not only by the amount given, but also by the extent to which it is formed internally and by the physiological capacity of the gland engaged in elaborating the inactivated secretion. Our experience with rabbits has suggested that the effect of injected pituitrin upon the percentage of sugar in the blood is related to the fasting-sugar content; those with the high fasting sugars—in which there is possibly a condition of hyperpituitarism with a relative deficiency of the internal secretion of the pancreas—showing a much more pronounced rise for a particular dose, and a proportionally larger increase in the percentage of the blood-sugar for any given increase of the dose, than those in which the fasting blood-sugar was normal, and where it may be inferred that the internal secretory activity of the pancreas is also normal. Thus, a rabbit with a fasting blood-sugar of 114 mgm. per cent. showed a maximum blood-sugar of 140 mgm. per cent. after the injection of 0·25 c.c. of pituitrin, and 160 mgm. per cent. following 0·5 c.c. (fig. 1), whereas another with a fasting blood-sugar of 80 mgm. per cent. only rose to 90 mgm. per cent. and 92 mgm. per cent. after the same doses had been given (fig. 2).

In the course of our investigations into the blood changes induced by injections of pituitrin we found that if the percentage of hæmoglobin were estimated by an accurate method such as that of Newcomer (*Journ. Biol. Chem.*, 1919, xxxvii, p. 465), at regular short intervals there was a steady fall as long as the percentage of sugar was increasing, followed by a rise as the sugar diminished again, so that when the

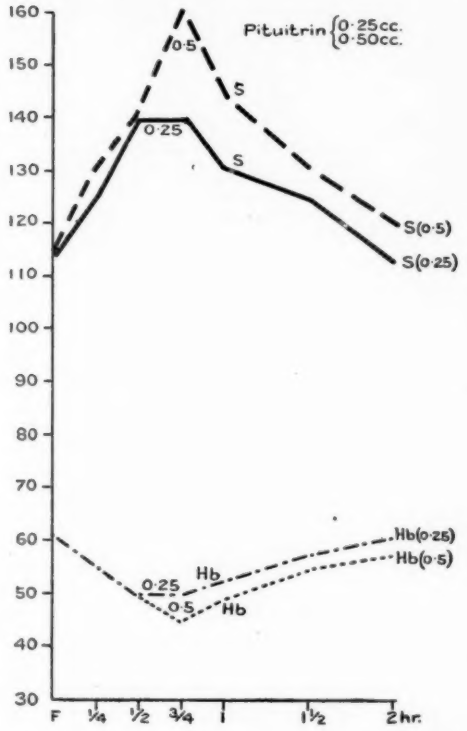

FIG. 1.—Effects produced on the blood-sugar (S.) and hæmoglobin (Hb.) by injecting 0·25 c.c. and 0·5 c.c. of pituitrin subcutaneously into "high blood-sugar" rabbits.

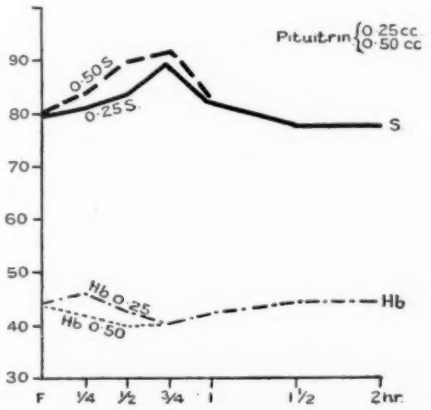

FIG. 2.—Effects produced on the blood-sugar (S.) and hæmoglobin (Hb.) by injecting 0·25 c.c. and 0·5 c.c. of pituitrin subcutaneously into "low blood-sugar" rabbits.

hæmoglobin and sugar curves were plotted out the one was the reverse of the other. As erythrocyte counts, carried out under the same conditions, gave similar curves to those shown by the hæmoglobin, it is evident that the variations in the latter are due to a progressive dilution of the blood succeeded by a corresponding concentration, until the fasting condition is regained. The variations in volume which these results indicate no doubt affect all the constituents, so that the percentages actually found are not a correct measure of the alterations which really occur when pituitrin is injected. If we wish to ascertain the true increase in the sugar, for example, we

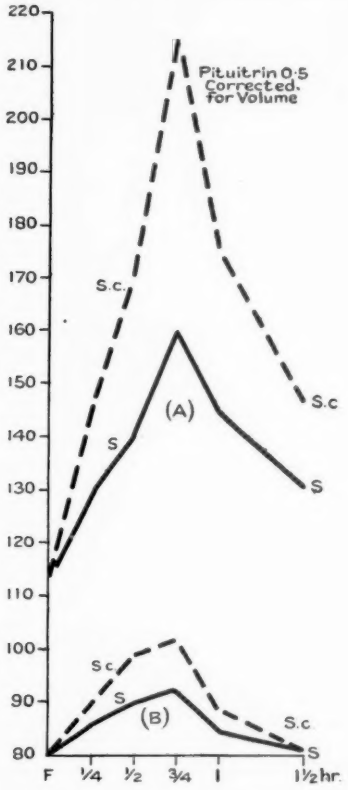

FIG. 3.—Blood-sugar curves of "high" (A.) and "low" (B.) sugar rabbits after injecting 0·5 c.c. of pituitrin as actually found (S.) and corrected for volume (S.c.).

must allow for the dilution, so that in the first of the two rabbits previously mentioned (p. 38) the maximum sugar found after 0·25 c.c. of pituitrin had been injected (140 mgm. per cent.) would, when allowance has been made for the dilution indicated by the fall in the hæmoglobin from 61 per cent. to 50 per cent., be increased to 171 mgm. per cent.; again, as the hæmoglobin fell from 61 per cent. to 45 per cent. after 0·5 c.c. had been injected, the true increase in the blood-sugar would be represented by 217 mgm. per cent. and not 160 mgm. per cent. as was actually found (figs. 1, 3). The drop in the hæmoglobin of the second rabbit's blood was much less—4 per cent.—after both

0·25 c.c. and 0·5 c.c., so that the corrected figures for the sugar were 92 mgm. and 101 mgm. respectively (figs. 2, 3). It is possible that the dilution of the blood which takes place when pituitrin is introduced into the circulation is a protective mechanism, designed to guard the tissues, and particularly the nervous system, against the effects of a high blood-sugar, and also to bring about the removal of the excess of sugar as quickly as possible, since the fall in the percentage of calcium in the blood which results from the dilution will increase the permeability of the kidneys for sugar and ensure its excretion in the urine at a point below the normal threshold, as Hamburger's experiments have shown.

The effects of insulin injections on the volume of the blood are interesting. When a small dose, one unit, is given to a rabbit with a high fasting blood-sugar, and examinations are made at intervals of a quarter of an hour, the first change is a fall in the hæmoglobin, associated with a rise in the sugar; there is then a rapid return to the

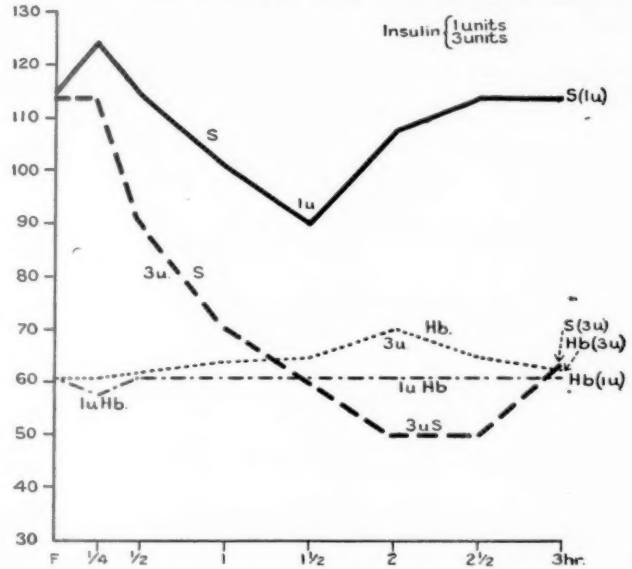

FIG. 4.—Effects produced on the blood-sugar (S.) and hæmoglobin (Hb.) by injecting one unit and three units of insulin subcutaneously into "high blood-sugar" rabbits.

fasting level, and subsequently the sugar continues to fall without any appreciable alteration in the percentage of hæmoglobin (fig. 4). With a larger dose—three units—the preliminary rise in the sugar and fall in the hæmoglobin are no longer evident, the values being the same at the quarter hour as before the injection; the succeeding fall in the sugar is greater and more prolonged, and is now associated with a steadily developed increase in the hæmoglobin, which reaches its maximum when the sugar is at its minimum. Rabbits with a low fasting blood-sugar show a preliminary rise in the sugar and fall in the hæmoglobin after one unit of insulin, like those with a high blood-sugar as a rule, but both are less pronounced, and if two units are given these changes are no longer evident, though they still occur in the high blood-sugar rabbits after the same dose. Doses of two or three units are followed by a much more rapid and well developed rise in the hæmoglobin of the low than of the high blood-sugar rabbits, and with the larger amount this continues until convulsions supervene, when

an extreme concentration of the blood is indicated (fig. 5). Bearing in mind the results of our previous experiments it would seem probable that these findings may be explained by the influence of the injected insulin upon the activity of the animal's pituitary, and its chemical interaction with the secretion of the gland. Small doses would appear to cause a secretion of pituitrin into the general circulation, with the result that the volume of the blood is increased, and the sugar rises for a brief period, especially in animals with a high fasting blood-sugar; the excess is quickly inactivated, however, and the blood-sugar drops owing to the action of the remaining insulin. When larger doses are injected, or the fasting blood-sugar is low, the preliminary increase in volume and rise in the blood-sugar are either less pronounced or are missing, because the initial stimulating effect of the injection upon the pituitary is then more rapidly masked, and since a distinct rise in the hæmoglobin follows as the percentage of sugar falls in such animals, it would appear that a condition of hypopituitarism is developed, giving rise to pronounced concentration of the blood, and consequently a much greater diminution in the sugar than is indicated by the percentage at the time when the convulsions and other symptoms of "hypoglycæmia" develop. As rabbits with a low fasting blood-sugar appear to be more susceptible to insulin than those in which it is relatively high, it would seem probable that in the

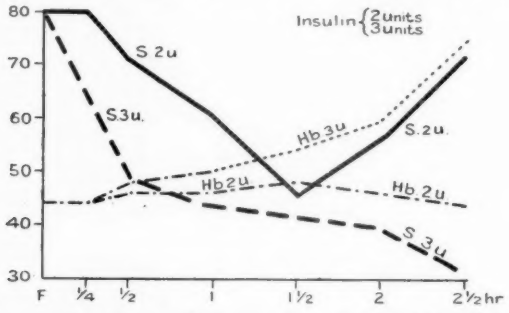

FIG. 5.—Effects produced on the blood-sugar (S.) and hæmoglobin (Hb.) by injecting two units and three units of insulin subcutaneously into "low blood-sugar" rabbits.

former there is naturally a relative excess of the internal secretion of the pancreas, just as there is naturally hyperactivity of the pituitary in the latter, as we have already seen. In this way we can explain the varying effects of insulin and pituitrin on different animals, and account for the changes they both produce in the volume of the blood.

The results of similar experiments have shown that adrenalin, thyroid and feeding have no appreciable influence upon the blood volume, and the same is true of parathyroid unless it is given in large doses, when there are slight changes resembling those produced by insulin, probably owing to the activating effect of the parathyroid upon the internal secretion of the animal's own pancreas. Distinct and regular variations in the volume of the blood, as indicated by changes in the percentage of hæmoglobin or erythrocyte counts, from the fasting level after a meal, when the functions of the various endocrine glands concerned in carbohydrate metabolism are brought into play, would therefore seem to offer a means of diagnosing with a considerable degree of certainty alterations in the activity of the pituitary.

Acromegaly is a rare disease in its typical form, but is important in our present study of glycosuria, as, its pathology being known, it enables us to determine whether the blood changes artificially produced in animals also occur in human beings. I have had the opportunity of closely observing two cases, one for eight

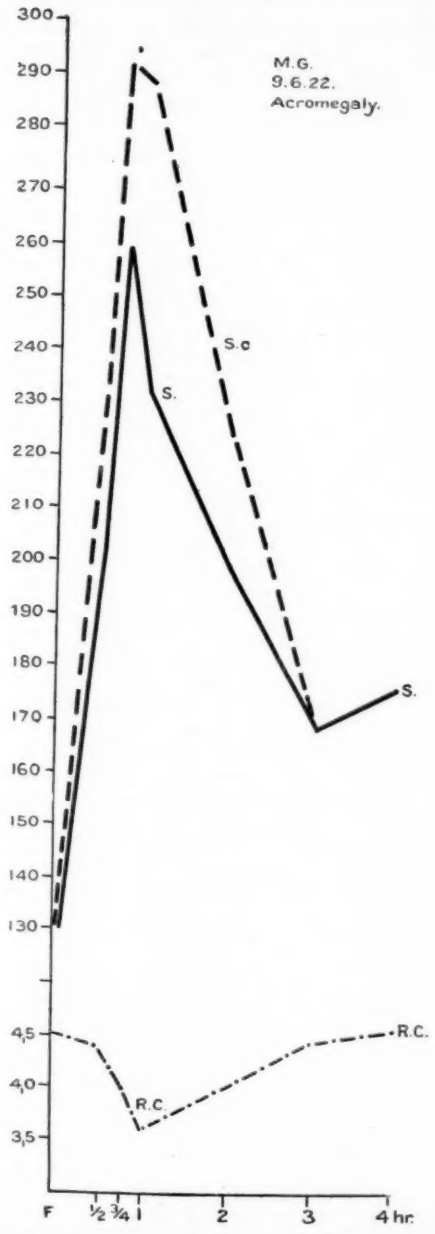

FIG. 6.—Effects on the erythrocyte counts (R.C.) and blood-sugar (S.) of a test-meal in a case of acromegaly, with the blood-sugar curve corrected for volume (S.c.).

years and the other for four. In both there was well-marked glycosuria when they were first seen, and analysis of their blood before and after a test-meal showed evidences of a dilution similar to that met with in rabbits following an injection of pituitrin (fig. 6). No indication of any deficiency of the internal secretion of the pancreas could be discovered in either case, the glycosuria being apparently due entirely to hyperactivity of the pituitary, with consequent partial inactivation of the normal secretion of insulin. Careful dieting controlled the glycosuria in both cases, and in one the carbohydrate tolerance gradually increased, so that eventually comparatively little restriction of the diet was required. On examining the blood of this patient, it seemed that the original hyperpituitarism had been replaced by the reverse condition, as a test-meal was followed by a concentration instead of a dilution of the blood.

Making use of the information obtained in this way, we have investigated the blood of a large number of cases of glycosuria, and have found that disturbances in the activity of the pituitary not only enter into the pathology of many typical diabetics, but also form the essential feature of a group which, although not presenting the typical clinical features of acromegaly, are apparently related to it. This condition appears to be more common in females than in males. The patients are almost invariably energetic, and are well developed both mentally and physically. They generally look the picture of health, unless there is some complication and the condition is not of the pure pituitary type. Sugar is discovered in the urine most frequently between the ages of fourteen and eighteen, but it is not uncommonly detected later in life during a routine examination for insurance or some other purpose. Occasionally a typical pituitary glycosuria appears to develop about the climacteric, and is found in old men as well as in women. In one of my patients such a condition appeared shortly after a double ovariotomy. In uncomplicated cases analysis of the blood shows a normal or subnormal percentage of sugar fasting, and after a meal a rise insufficient to account for the amount of sugar passed in the urine occurs; as a consequence such cases are often classified as "renal" diabetics. Serial estimations of the hæmoglobin or erythrocyte counts, made at the same time as the percentage of sugar is determined, show, however, that there is a progressive dilution of the blood as the sugar increases, thus accounting for the glycosuria with an apparently low blood-sugar, as in susceptible animals which have been injected with pituitrin (fig. 7). It would therefore seem probable that these patients inherit, or acquire, a pituitary which is hyperactive relatively to their pancreas, and as a consequence of this lack of balance, pass sugar in their urine on a low blood-sugar whenever their endocrine system is stimulated from any cause.

If we follow present-day usage and regard disease of the pancreas as the essential feature of diabetes, these patients are not "diabetic," but it is easier to draw the distinction in theory than in practice, as the following case shows:—In November, 1914, I was asked by Dr. Cornish to see with him a lady, aged 20, who was about three months pregnant with her first child. Sugar had been detected accidentally about four years previously, but the amount had never been large. Examination of her urine showed 3·5 per cent. of sugar with a total of 82 grm., 1·4 grm. of acetone, and 3·7 grm. of oxybutyric acid, an apparently typical diabetic condition with serious acidosis. Treatment on the lines then generally adopted did not prove very satisfactory, and eventually it was decided to terminate the pregnancy. Improvement rapidly followed, all traces of acetone bodies disappearing within a week, and the urinary sugar dropping to between 5 and 10 grm. a day. It was also noticed that the blood-sugar, which previously had been found as high as 350 mgm., was now often as low as 40 mgm. per cent. Although the patient was warned that it was dangerous for her to have children, she found she was pregnant in December, 1915. This pregnancy was carefully watched, and was carried to term without any serious acidosis or increase in the urinary sugar, and with a blood-sugar which rarely exceeded

180 mgm. per cent. A serial analysis of the patient's blood carried out shortly afterwards showed that it ranged from 50 mgm. fasting to a maximum of 150 mgm. per cent. three hours after a test-meal. The case was therefore classified as one of "renal glycosuria," with a temporary true diabetes engrafted during the first

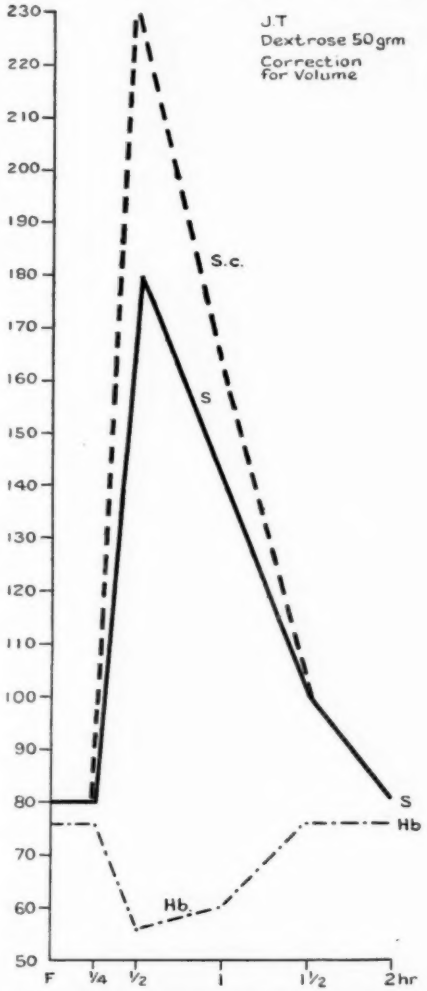

FIG. 7.—Effects of a test-meal of dextrose (50 grm.) in a case of simple "pituitary glycosuria" on the hæmoglobin (Hb.), and blood-sugar (S.), with the blood-sugar curve corrected for volume (S.c.).

pregnancy. In September, 1919, a third child was born, after an uneventful history, although sugar was persistently present in the urine. Subsequently, the glycosuria continued, the sugar varying from 5 grm. a day, when a moderately restricted diet was adhered to; and rising to as much as 50 or 60 grm., when all restrictions were

disregarded. The true nature of the case was not discovered until we had differentiated the pituitary type of which I have been speaking, and it was then found that the low blood-sugars were fictitious and due to dilution of the blood. Further examination revealed no evidence of any deficiency of the internal secretion of the pancreas, so that, according to current views, the patient is not "diabetic," although her urine is never free from sugar, and she has actually an excess of sugar in her blood. No unbiased observer who saw her in her first pregnancy would have hesitated in his diagnosis, however. Probably there was a pancreatic deficiency at the time, but it seems likely it was functional and relative, arising from the increased activity of an already hyperactive pituitary and the rapidly growing needs of the parasitic fœtus, rather than organic and absolute, resulting from disease of the pancreas. The reduced carbohydrate tolerance commonly met with in the later months of all pregnancies can probably be partly explained on similar lines, and may be a protective process designed to prevent the fœtal pancreas from unduly increasing the proportion of active insulin in the maternal circulation.

Although patients suffering from pituitary glycosuria often require careful dieting for a time in order to obtain physiological rest for a pancreas which is functionally exhausted, permanent reduction of the carbohydrate to a level necessary to secure a sugar-free urine is inadvisable and apparently unnecessary. A restriction of the protein and fat is usually more beneficial than strict limitation of the carbohydrate, and so long as the excretion of sugar in the urine is kept within moderate limits, they appear to remain in perfect health for an indefinite period and are even able to follow a strenuous occupation. One of my patients, who has been under observation for eighteen years, and is known to have had glycosuria for over twenty, regularly passes from 30 to 40 grm. of sugar a day, and yet works long hours as a dancing mistress. Insulin may be of temporary benefit but relatively large doses are usually needed, and its continuous use appears to give rise to a condition of pituitary exhaustion with polyuria, frequency of micturition, and weakness, which, in one instance coming to my knowledge, ended in sudden death from heart failure.

There is a pituitary element in many cases of true diabetes, primarily due to organic pancreatic deficiency, and this has an important bearing upon the dosage and effects of insulin. If the pituitary is hyperactive more insulin is required to control the glycosuria than would be expected from the amount of sugar passed in the urine or from the sugar content of the blood, and the spacing of the doses often needs very careful adjustment if the best results are to be obtained. Since insulin probably stimulates and then exhausts the pituitary, the relative effects varying according to the amount given, as in rabbits, and part of the injected dose being inactivated in any case by the pituitrin entering the circulation, it is evident that the useful effect upon the hyperglycæmia induced by a succeeding meal will vary, and that unless the optimum dose and time of administration in relation to the meal are actually determined by serial examinations of the blood, errors in amount and spacing are very likely to occur. Over-dosing, in an attempt to keep the urine permanently sugar-free, is the most common mistake and is particularly harmful, as it leads to pituitary exhaustion with consequent polyuria, and may cause the sudden appearance of hypoglycæmic symptoms without any alteration in the dose. In cases in which hypopituitarism exists when the treatment is commenced the problem is usually easier, but the patients are remarkably sensitive to insulin and the dose should be increased very cautiously. Occasionally patients are met with in whom the two conditions appear to alternate, and we can then only regulate the treatment by estimating the sugar in the blood at frequent intervals, making due allowance for any alteration in volume indicated by distinct variations in the hæmoglobin or erythrocyte counts.

Hypoglycæmia.

By O. Leyton, M.D.

More than a dozen years ago, F. Allen showed that overwork of the islands of Langerhans in the pancreas led to their destruction. Founded upon this he devised a treatment of diabetes mellitus by fasting followed by a progressive diet.

At first it was thought that if the diet were restricted to prevent glycosuria the disease would be arrested, but very soon many found that patients who had been free from sugar in their urine for weeks or months gradually re-developed glycosuria and it was controlled only by further reduction in the diet.

Obviously the islands of Langerhans which had survived the attack leading to diabetes mellitus might be overworked even in the absence of glycosuria. This is easily understood when it is realized that the normal renal threshold for dextrose is approximately double the average amount of sugar in the blood.

The next move in the treatment was to arrange the diet in order to prevent the sugar in the blood rising sufficiently to stimulate the cells of the islets of Langerhans. This percentage had to be arbitrary: for my own purpose I assumed that the sugar content of the blood should not rise above 0·15 per cent. When the diet was such as to prevent the sugar in the blood of the patient rising at any time above 0·15 per cent., the disease was arrested and frequently the tolerance of the patient increased slowly.

This experience was that of all who treated their patients in a way which insured that the blood-sugar never rose above 0·15 per cent., an occasional estimation of the sugar in the blood is useless; a series of samples of blood have to be taken at comparatively short intervals after each meal containing carbohydrate to see that at no time after the meal does the sugar rise too high. Also blood samples must be taken early in the morning. This principle of treatment has not been altered through the introduction of insulin.

In the majority of cases which have come under my care (about 500) an attempt has been made to prevent hyperglycæmia at any time of day and therefore the majority have had hypoglycæmic attacks.

This onset of hypoglycæmic symptoms seems to depend upon something besides the percentage of sugar in the blood: it is not possible to say that hypoglycæmia is a state in which the percentage of sugar in the blood falls below 0·075 per cent., because some patients have symptoms with a blood-sugar of 0·08 per cent. whilst others are apparently quite normal with only 0·04 per cent. sugar in their blood. My experience does not confirm that of those who state that symptoms depend upon the difference in the percentage of sugar in the blood and that a patient who has had, say, 0·40 per cent. blood-sugar for some months will develop hypoglycæmic symptoms at a higher level than one who has had a blood-sugar of 0·20 per cent. The symptoms are extremely varied. Amongst those of common occurrence are the following: (*a*) apprehension; (*b*) coarse tremor; (*c*) sweating; (*d*) intense muscular weakness; (*e*) difficulty in articulation; (*f*) convulsions; (*g*) coma.

The less common, unimportant symptoms which have been reported to me are these: (*a*) a sensation of wetness behind the eyes; (*b*) an itching of the skin as if a new coarse woollen vest were being worn; (*c*) an alteration in sight leading to misjudgment of the position of a golf ball; (*d*) diplopia (only important when it leads to an incorrect diagnosis).

The more important are the changes in the mental condition. Some patients during a hypoglycæmic attack behave as if they were intoxicated with alcohol or demented.

One of my most sober patients had some friends to a meal and began by pressing them to help themselves more liberally to pepper; then, most excitedly in a loud voice, he hurled insulting

epithets at his wife, who recognizing the condition besought him to take some sugar. He replied that of course she wanted him to take sugar, a thing the doctor had forbidden him, so that she might get rid of him and marry someone else. This patient was forced to take sugar; the symptoms passed within half an hour and he had no recollection of what had occurred.

In another case a patient administered to himself too large a dose of insulin, which led to symptoms graphically described in the following letter quoted:—

> "After lunch he looked ghastly and for about an hour and a half he was very restless, excitable, making mysterious signs, laughing at nothing (he never laughs), making occasional spasmodic movements. Then he began to stretch his hands behind his head and giggle and laugh and then for ten minutes or a quarter of an hour he appeared to be quite insane.
>
> "He sprang in the air and twisted like a professional contortionist, he stood on his head in an armchair and made gurgling noises, he turned on his back and shot his legs out in front of him.
>
> "I could do nothing with him, so sent for a doctor who lives near, but he was out.
>
> "Suddenly he pitched against an armchair and went down on to the floor with the armchair knocked over also. This seemed to bring him to himself and he was subdued and spoke sanely, though he still looked frightfully ill.
>
> "I implored him to take some sugar, but he would not until he had taken a blood test. This he found very low, about 0·06 per cent., so he took sugar and cake."

I have heard that one patient whom I saw on one occasion some years ago developed diplopia, together with some mental change, which led her medical adviser to make the diagnosis of encephalitis lethargica.

Some patients evince a great aversion to taking sugar during an attack, and assert that they are quite well and that their relatives are behaving peculiarly, whilst others recognize that they are hypoglycæmic. The rapidity of the onset may be alarming; I have known a patient lose consciousness suddenly whilst washing and only just escape being drowned by falling with her face in the basin of water.

The causes of hypoglycæmia are manifold; I know some of the causes and am ignorant of others. It is this ignorance which has led me to read this paper, hoping that some of the members of this Society will be able to explain cases which I shall describe shortly.

Of course, an overdose of insulin, or too little carbohydrate in the food for a certain dose of insulin, will lead to hypoglycæmia. Perhaps one of the commonest causes of an overdose of insulin is a low renal threshold for sugar in the patient under treatment when reliance is placed on examination of the urine instead of the blood.

It is easy to understand that if sugar appears in the urine when the sugar in the blood is as low as 0·12 per cent., any attempt to make the urine sugar free by the administration of insulin must lead to hypoglycæmia. This is one of several reasons that make it imperative to examine the sugar in the blood when treating a case of diabetes mellitus with insulin. That is so simple a matter that it is not necessary to elaborate it, but hypoglycæmic attacks may occur in patients who for years have been taking a fixed diet and a fixed dose of insulin.

These attacks, I imagine, are due to some delay in the absorption of food although sometimes it is not easy to understand why this has occurred. I know that occasionally it is due to delay in absorption during or following emotional disturbance.

One of my first cases of this kind was due to the patient having a heated discussion with his brother shortly after breakfast; towards mid-day the patient lost consciousness but was restored rapidly with sugar. The local medical adviser who at that time had not seen any cases of hypoglycæmia was under the impression that the patient had had an epileptic attack and he was therefore unwilling to awaken him and administer sugar.

I have known the excitement of a game of chess disturb absorption or even a lecture on

some political matter. The case arising from the last-mentioned cause was of some interest because it occurred in a man who had taken insulin for years and had discarded the little box with two lumps of sugar which he had carried for two years and never had needed. On the way home he felt giddy, tried to support himself by holding the railings, slipped down on to the pavement: on regaining consciousness, he walked home, when he found that nearly two hours were not accounted for, so that he must have been unconscious for close upon that time. His medical adviser sent him to bed for three weeks in the belief that the patient's seizure must have been a heart attack.

The unwise use of aperients will lead to hypoglycæmia by hurrying a meal through the intestine and preventing absorption.

I now come to the unknown cause, but before referring to that I should mention that substances other than insulin lead to a fall of sugar in the blood. It has been known for some time that certain peptones produce that effect. By a lucky chance my former first assistant, Dr. Gerald Slot, and I have ascertained that histamine, too, reduces the sugar in the blood of a rabbit; 3 mgm. histamine having an effect identical with 1 unit of insulin. This was the reverse of what we expected before the observations were made.

Of the 500 cases of diabetes mellitus treated with insulin, I have heard that four patients have died from what I imagine was hypoglycæmia. One death was due to an error in treatment; insulin was continued whilst the patient vomited, and when the local practitioner was found he was too late to give injections of sugar. The other three cases, two of which I have been able to observe, have had hypoglycæmia due to some cause of which I am ignorant.

E. T., male aged 29, was admitted to the London Hospital, November 3, 1926.

The patient had suffered from diabetes mellitus for four years, was wasted and had glycosuria and ketosis. The sugar in his blood was 0·28 per cent. one hour after his mid-day meal. Upon a diet of carbohydrate 50 grm., protein 90 grm., and fat 130 grm. he needed 10 units of insulin before breakfast and 10 units before the evening meal to keep the sugar in his blood one hour after the mid-day meal in the region of 0·12 per cent.

After eleven days' treatment he was found to be gaining weight steadily and was apparently stabilized; the dose of insulin and the diet having been kept the same for a week. He was to have left the hospital on November 15, but at 1 o'clock that morning he became demented, screaming loudly. The house-physician administered a narcotic and wisely took a sample of blood, which proved later to contain only 0·015 per cent. sugar.

At 7 in the morning, the patient was slightly lethargic but otherwise normal and was given 10 units of insulin and a breakfast containing 18 grm. of carbohydrate. At 9 o'clock he lost consciousness, another sample of blood was taken and since it contained only 0·015 per cent. sugar 52 grm. dextrose were given intravenously. Coma persisted and therefore my house-physician injected strychnine and camphor without any result.

The urine passed at 5 o'clock in the afternoon reduced Fehling's solution and also that collected at 9 p.m., whilst the sugar in the blood at that time was 0·117 per cent. On November 16 the urine passed at 9 a.m. contained a trace of sugar. Lumbar puncture failed to reveal anything abnormal.

At mid-day and also at 2 p.m. the sugar in the blood was 0·117 per cent.

That afternoon I examined the patient and failed to find any evidence of cerebral hæmorrhage or encephalitis lethargica, and therefore I ordered more sugar. Since the veins were very small 18 grm. of dextrose were given subcutaneously.

I had seen coma persist in a patient with a blood-sugar of 0·125 per cent., and therefore was inclined to take the view that the patient was suffering from hypoglycæmia.

Adrenalin was administered intramuscularly but failed to produce any effect.

Since consciousness did not return I ordered sugar to be placed in the stomach; upon Dr. Marrack's suggestion sodium phosphate was given with it, 45 grm. dextrose and 15 grm. sodium phosphate being poured into the stomach through a tube. Coma persisted: at 10.30 p.m. 9 grm. dextrose were given subcutaneously.

November 17.—The urine at 9 a.m. contained sugar. Blood taken at 11.30, but unfortunately not examined until the afternoon, contained 0·02 per cent. dextrose.

The patient died at 1.30 p.m., i.e., fifty-two hours after the last injection of insulin, during which time 142 grm. of carbohydrate had been given.

My opinion is that if the administration of dextrose had been persisted in the patient would have recovered, but I imagine that the glycosuria led to an incorrect conclusion.

Another case occurred in my practice at the London Hospital some years previously, but there was less opportunity of studying the patient because he was admitted in a state of coma. He was given large doses of insulin, regaining consciousness, but died thirty-six hours after the last injection of insulin, in spite of bread and other carbohydrates, along with injections of dextrose, having been given during the interval.

These cases are not confined to my practice ; several have been recorded, but, as far as I know, no explanation has been offered, and I regret that I, too, have none to offer.

Examination of the tissues, post mortem, shows an average amount of glycogen in the body, and therefore it cannot be due to the treatment having led to the glycogen being exhausted and none left to be called upon in case of need. It may be that some substance other than insulin is formed which possesses the property of reducing the amount of sugar in the blood ; we know that peptones and probably histamine can effect this reduction. It is difficult to believe that the β-cells of the islands of Langerhans, which for years have been unable to make sufficient insulin, should suddenly produce excess and continue to do so in the absence of the stimulus of sugar in the blood.

Luckily these cases are extremely rare. If another such case comes in my way I shall insist on intravenous injections of sugar being given until the blood contains at least 0·2 per cent. for several hours. If unconsciousness persists with this hyperglycæmia, then, and then only, shall I change the diagnosis of hypoglycæmia.

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A Case of Pontine Glioma, with Special Reference to the Paths of Gustatory Sensation.

By Wilfred Harris, M.D., with Pathological Account by W. D. Newcomb, M.D.

The genesis of the paper which we present to-night was provided by a remarkable case of pontine glioma which was under the care of one of us last year in St. Mary's Hospital. The patient was a boy, aged 14, remarkably intelligent, and quick to appreciate the various tests of sensation and of taste which were tried repeatedly during the first three weeks, and one whose answers we are convinced may be relied on to be accurate.

The boy died after he had been in the hospital a little under two months, on Christmas Day, 1924, an unfortunate date from the pathological point of view, as the autopsy was not done until two days later. For the pathological description of the specimen and sections one of us (W. D. N.) is responsible, while for the clinical description and tests, with the discussion on the physiological functions of the fifth nerve and the intrapontine connexions of the gustatory nucleus, the other (W. H.) is alone responsible.

The boy, L. V., received a blow on the head on August 9, 1924. Since then progressive physical weakness was observed. No headache or other pains followed immediately after the blow, but vomiting occurred seven days later. On August 31 he complained of severe left-sided headache, and he was then found to have slight weakness on the right side, with right extensor plantar reflex. He was admitted to the Bromley Cottage Hospital on September 3, where two operations were performed on the left mastoid. Exploration for subdural abscess was carried out, but no suppuration was discovered, the last operation being done on September 21. He was sent to me at St. Mary's Hospital by his doctor on October 31, 1924.

There was then well-marked spastic right hemiplegia of arm and leg, but no noticeable weakness of the right side of the face. There was well-marked right hemianæsthesia of the whole of the right side, head and face, arm, trunk and leg. There was conjugate weakness of both eyes towards the left, with coarse nystagmus to the right, left facial nerve palsy, left motor fifth nerve palsy, and tactile anæsthesia of the left trigeminal area, but no loss to pin-prick or to temperature sense, which were both normal on the left side of the face.

Taste was completely lost on both sides of the front of the tongue, and also at the back of the tongue on the right side, though on the left side at the back he could recognize sweet taste at once.

There was also bilateral paralysis of the soft palate, with very nasal voice, but the vocal cords were not examined. Swallowing and protrusion of the tongue became progressively more difficult, and the articulation became almost impossible to understand after he had been a month in hospital, while by this time the conjugate movement of the two eyes to the left was completely paralysed.

No papillœdema developed while under observation, but the clinical diagnosis of glioma of the left side of the pons was easy. The spastic right hemiplegia of arm and leg without involvement of the right lower face, but with left facial nerve palsy, indicated the position of the growth at the level of the left sixth and seventh nuclei, thus accounting for the conjugate palsy of the two eyes towards the left. The total right hemianæsthesia, however, including the right side of the face, indicated a lesion involving the left median fillet, well above the fifth nerve nucleus, and the partial left fifth nerve palsy indicated that the convolutio trigemini was involved in the growth. It appeared therefore that the disease extended at least as high as the upper part of the pons on the left side, while the bilateral palatal palsy pointed to the nucleus ambiguus on each side in the medulla being affected.

How far the clinical diagnosis was justified will be seen from a consideration of the pathological findings, after which we shall deal more in detail with the explanations of the partial fifth nerve paralysis and the bilateral loss of taste.

A glio-sarcoma of the pons and medulla was found, extending into the left crus as high as the red nucleus and downwards as far as the lower border of the olive. In the centre of the pons, sections showed that the growth had spread to a considerable extent across the middle line into the right half of the pons, though the staining of the sections was in places unsatisfactory owing to post-mortem changes.

The sections of the tumour shown indicate a much wider spread of the growth than was to be expected from the clinical examination. Thus a section through the middle and upper part of the pons shows the larger portion of the right side to be infiltrated by the growth, as well as the left side, nor can the spinal root of the left fifth nerve and the lower part of the gustatory nucleus, with the fasciculus solitarius, be demonstrated to have escaped damage. It is practically certain that the growth increased considerably in extent in the six weeks after his clinical examination, during which interval he gradually became too paralysed for accurate examination.

On admission, examination of the fifth nerves revealed no motor paralysis on the right side, the masseter contracting well, but on the left side there was partial motor fifth paralysis, no contraction of the masseter or temporal muscles being palpable on biting, though the right masseter stood out well. On opening the mouth the jaw did not deviate to either side, so we may either assume that the external pterygoid on the left side was unaffected, or else that its weakness was counterbalanced by hemiplegic weakness of the corresponding movement on the right side. Testing the face for sensation disclosed loss to tactile sensation and to pin-prick on the right side—part of the general right hemianæsthesia; whilst on the left side of the face there was a dissociated anæsthesia of the trigeminal area only, light touches being unperceived, though pin-pricks and temperature tests were recognized normally. The explanation of this left-sided motor palsy and dissociated anæsthesia of the fifth nerve would involve the occurrence of the following events: (1) The escape of the spinal root of the trigeminal; (2) the damage by the growth of the convolutio trigemini or tactile nucleus of the fifth, and of the motor nucleus on its inner side, while the main sensory trunk of the fifth nerve which turns downwards at a right angle into the spinal root was unaffected.

Of particular interest is the bilateral loss of taste in this case, complete on the right side, both on the front and back of the tongue, while on the left side the loss of taste was limited to the front of the tongue, the back portion served by the glosso-pharyngeal nerve being normally sensitive to taste. The loss of taste on the right side is probably to be accounted for by the extension of the tumour upwards into the left crus, where the central continuations of the gustatory fibres, or gustatory fillet, after decussating from the right side across the middle line, are continued upwards on their way to the thalamus in the neighbourhood of the median fillet.

Before discussing the explanation of the preservation of taste on the back of the left side of the tongue, while it was completely lost on the front portion, it would, perhaps, be advisable to recapitulate briefly what is known of the afferent path of the taste fibres. It is generally accepted now that the chorda tympani carries taste impressions from the front two-thirds of the tongue; the nerve after parting company with the lingual joins the facial in the middle ear and ends in the geniculate ganglion. Although the geniculate ganglion has nerve connexions with both the second and third divisions of the fifth nerve by means of the great superficial petrosal and Vidian nerve to Meckel's ganglion, and by a connexion to the small superficial petrosal and thus to the otic ganglion, it is inconceivable that these can furnish, except in rare instances, the central continuation for impressions arriving by the chorda tympani. (*Diagram of fifth nerve connexions shown.*) Quite probably the great superficial petrosal conveys taste impressions from the palate to the geniculate

ganglion, just as the other main branch of the ganglion, the chorda tympani, conveys taste impressions from the tongue. Indeed, for many years it has been generally accepted that the central continuation of the chorda tympani fibres, and probably also of the great superficial petrosal, is by the pars intermedia Wrisbergi, which enters the pons between the facial and acoustic nerves and ends in the substantia gelatinosa around the upper end of the fasciculus solitarius, or ascending glosso-pharyngeal root. In 1906 Nageotte (*Rev. of Neur. and Psych.*, Edin., Vol. iv, p. 473) studied the central Marchi degeneration of the pars intermedia in a case in which the whole facial nerve was destroyed by a small metastatic nodule of carcinoma just on the distal side of the geniculate ganglion. Although no degeneration was to be seen in the nerve between the ganglion and the pons, yet as soon as the facial and pars intermedia fibres had shed their neurilemmal sheath of Schwann on entering the pons, typical Marchi degeneration was seen, called by Nageotte secondary transcellular degeneration. (*See* figs. 1 and 2 in Nageotte's paper.) He describes the fibres of the pars intermedia, or nerve of Wrisberg, as ending in the median portion of a nucleus continuous below with the substantia gelatinosa surrounding the upper portion of the ascending glosso-pharyngeal root, and reaching upwards to a point 2 mm. below the convolutio trigemini. This lies dorsal and internal to the spinal root of the fifth, with which it is in close connexion in its upper part. He names this nucleus the gustatory nucleus, as it receives fibres below from the glosso-pharyngeal, in its middle portion from the pars intermedia, and in its superior portion from the trigeminal nerve, all three of which nerves he considers to possess gustatory function. Though the central connexion of this gustatory nucleus has not been traced, it is practically certain that, like the fibres of the trigeminal fillet, nerve-fibres are continued from the inner side of the gustatory nucleus and decussate in the middle line to run upwards through the crus to the thalamus as a bundle, which is probably separate both from the main fillet and from the trigeminal fillet, and which may be called the gustatory fillet. (*Diagram of intrapontine fifth nerve connexions shown.*) There is some reason to believe that the gustatory fillet runs at first close to the median line after decussation, dorsal and external to the posterior longitudinal bundle.

A man, aged 46, had a "stroke" one morning, without any loss of consciousness, developing suddenly loss of power and numbness over the whole of his right side. The right knee-jerk was increased and the right plantar reflex was extensor; there was total right hemi-anæsthesia up to the middle line, including the face, even a hard squeeze on the arm or leg not being felt. There was total loss of the sense of position in the right arm, which, as he said, "got lost in bed," and when lying on his right side in bed he said he felt "as though he was suspended in the air under the bedclothes." At first there was complete bilateral loss of taste, though the anæsthesia included only the right half of the tongue and palate, but not the pharynx. The sense of taste afterwards improved on both sides, but as the pupils at first lost their light reaction, the lesion was probably high up in the pons, in the tegmentum, well above the level of the fifth nuclei. The bilateral loss of taste on both front and back of tongue and palate is probably to be explained by the thrombotic lesion in the tegmentum, which produced the dense cutaneous anæsthesia by involving the median fillet, also damaging the gustatory fillet of each side, which appears to run close to the median line in the tegmentum, on the outer side of the posterior longitudinal bundle.

Indeed, complete bilateral ageusia—with the remaining signs strictly one-sided, except possibly bilateral facial anæsthesia—may be taken as evidence of a lesion on one side of the pons reaching the middle line at and above the level of the fifth nerve nucleus.

Bilateral ageusia on the front two-thirds of the tongue was also present in the case of a solicitor, aged 52, seen by one of us (W.H.) twice and carefully examined, in 1912. He was a very intelligent man, and his answers to the tests were quick and definite. He was a sufferer from chronic syringobulbia, involving many cranial nerves on the left side. There was total left fifth nerve paralysis, both motor and sensory, coarse nystagmus, partial left

facial paralysis, left nerve deafness, and paralysis of the left soft palate and vocal cord, with diminished sensation on the left side of the pharynx. Taste was completely lost on both sides of the tongue as far back as the circumvallate papillæ. On the back of the tongue he could recognize at once sweet, salt and bitter, though less acutely on the left side. There was no sensation of taste at all on the soft palate on either side unless it was allowed to touch the back of the tongue, when he named the taste sensation at once. There was no detectable sensory loss on the right side of the tongue or face to pin-prick, temperature or light touch, though the left side of the tongue in front was completely anæsthetic to scratch and pressure of a pin.

This case illustrates the presence of bilateral ageusia on the front of the tongue, though there was no clinical evidence of either the right fifth or seventh nerves being affected. Unlike the case of pontine thrombosis previously described, and the case of pontine glioma, the specimens from which are shown to-night, the retention of taste on both sides of the back of the tongue is proof that the gustatory fillet on each side must have escaped, and the explanation of the bilateral ageusia on the front of the tongue is probably to be found in the syringal gliosis extending across the middle line and involving the upper two-thirds of the gustatory nuclei on both sides, together with the whole of the left fifth nucleus and its spinal root.

This case of syringobulbia also illustrates another point of interest, namely, that for many years the patient had been subject to attacks of vertigo severe enough to make him stagger as if drunk, with at the same time the appearance of stinging pains in the left cheek and flushing of the face. These symptoms may be ascribed to the lesion involving the spinal root of the left fifth nerve and the left inferior cerebellar peduncle.

Concluding Remarks by Dr. Wilfred Harris.

We must now sum up the evidence of the gustatory functions of the trigeminal, nerve of Wrisberg, and glosso-pharyngeal nerves.

In innumerable instances of facial nerve damage in the middle ear total and permanent loss of taste has been observed on the front of the tongue. I have also seen loss of taste in a case of geniculate herpes without facial paralysis, and in a case of gummatous meningitis causing total right seventh and eighth nerve paralysis, with partial right fifth nerve palsy; taste was totally lost on the front of the tongue on that side. Two months later the fifth nerve weakness had almost cleared up under treatment by biniodide of mercury, though the facial paralysis was still complete and the sense of taste was still almost completely lost on the right side. The findings in this case would support the view that the pars intermedia was the intracranial afferent path for taste from the front of the tongue. I have also seen taste on the front of one side of the tongue abolished as the result of an intracranial injection of the Gasserian ganglion in which leakage of alcohol into the lateral recess took place, causing temporary vertigo and vomiting, with nystagmus, and facial palsy which persisted for several weeks. In this case the loss of taste on the tongue must have been due to the involvement of the nerve of Wrisberg with the facial nerve near the side of the pons, and could not be ascribed to the Gasserian destruction, as only the inner two-thirds of the ganglion were made anæsthetic, the third division with the tongue having escaped entirely.

On the other hand, fifth nerve damage has frequently been found to be associated with loss of taste, and I have seen numerous cases of complete fifth nerve palsy with total loss of taste on the front of the tongue, and occasionally also on the back of the tongue, in cases of cerebral gumma, fractured base, &c. Doyle, of the Mayo Clinic, in 1923 published a case of paroxysmal neuralgia in which the sensory root of the right trigeminal nerve was avulsed, and later the glosso-pharyngeal nerve on that side also. After the second operation total loss of taste was found on the right side, both on the front and back of the tongue and palate. Taste was not tested before the second operation on the glosso-pharyngeal, but it can scarcely be suggested

seriously that the glosso-pharyngeal can be the gustatory nerve for the front two-thirds of the tongue. In this case there is no reason to ascribe the loss of taste to the nerve of Wrisberg, and it seems impossible to deny the gustatory function of the fifth nerve.

The most convincing evidence that I can present of the gustatory function of the fifth nerve, both of the second and third divisions, is to be found in the results of careful tests of cases of trigeminal neuralgia in which I have injected the foramen ovale with 90 per cent. alcohol, producing complete anæsthesia of the third division of the fifth nerve. In numerous cases the Gasserian ganglion has been injected through the foramen ovale; in some of these partial ganglion anæsthesia has resulted, and in scores of other cases there has been permanent and total ganglion anæsthesia, in which all three divisions of the nerve have remained completely anæsthetic to every form of stimuli. Analysis of my notes in which taste was carefully tested shows eighty-six cases in which total loss of taste on one side of the tongue was found immediately after injection of the foramen ovale, though taste was at once recognized on the other side. In some of these cases taste has slowly returned to the normal, in others it has returned only partially, while in many total loss of taste for months or even years has persisted. I have also seen bilateral loss of taste on the front of the tongue persist after injection and destruction of the Gasserian ganglion on both sides, though taste was still acute at the back of the tongue. (*Diagram of nerve connexions shown*).

How can these apparently conflicting results be reconciled, that lesions of either the chorda tympani or of the third division of the fifth nerve may abolish the sensation of taste on the anterior two-thirds of the tongue?

If the postulate be accepted that the chorda fibres are continued centralwards to the gustatory nucleus in the pons by means of the nerve of Wrisberg, which, indeed, Nageotte's work conclusively proves, the question at once arises, what is the connexion between destruction of the third division of the fifth nerve and the loss of taste which so frequently instantly follows it?

Rejecting Nageotte's suggestion as insufficiently proved, that the lingual nerve is also gustatory in function, an answer to the problem may be found if we consider that taste is a complex function, requiring in many people, probably the majority, the presence of common sensibility of the mucous membrane of the tongue and palate for the proper appreciation of gustatory stimuli; also requiring that in these persons an interdependence of the activities of the lingual nerve and the chorda tympani is necessary for the full development of a taste sensation, and that a lesion of either path is therefore sufficient to prevent either from functioning alone as a gustatory nerve. (*Diagram of pons shown.*) We should probably consider this the clue to the explanation of Nageotte's description of trigeminal fibres ending in the upper portion of the gustatory nucleus in proximity to the terminations of the fibres of the pars intermedia—and even of the glosso-pharyngeal—rather than assume that each of these nerves is self-contained in its gustatory function.

An illustration of the probability of such correlation of function in these two nerves is evident when careful tests of the sensations of taste are undertaken. If the tongue is kept protruded and gently dried while various tests are applied in solution to the side of the tongue, such as syrup, saline and quinine, the majority of individuals are unable to indicate, by pointing to printed labels, which of these tests is being used, though evidently some gustatory sensation is perceived, and it is not until they are permitted to withdraw the tongue into the mouth and move it about that the full sense of taste is developed. Occasionally individuals are met with who are unable to perceive any sensation of taste when solutions are painted on the tongue, so long as the tongue is kept protruded, though as soon as the tongue is withdrawn into the mouth the correct taste sensation is appreciated and named within two or three seconds.

Section of Neurology.[1]

President—Dr. H. Campbell Thomson.

A Case of Post-Encephalitic Parkinsonian Syndrome without History of Encephalitis.

By Wilfred Harris, M.D.

C. B., aged 16½. About eight months ago he noticed that he dragged his left foot, especially after walking for any distance. Two months later he found that his left arm would "stick to his side," and when he moved it he had pain in the upper arm, so that he used only one hand at his work—typewriting. He would drop things from his left hand, which has felt colder than the right. Two months ago he noticed that he dribbled from his mouth on to the pillow. His mother remarked about his slow movements fifteen months ago, but his speed has improved during the last four months.

There is no history of any illness or of any symptom (e.g., diplopia or insomnia) resembling an acute attack of encephalitis lethargica, although the patient has the typical Parkinsonian syndrome.

Condition on admission.—Patient is well nourished, but has an expressionless aspect and staring facies. His gait is stiff and he holds his head and left arm still in walking; tendency to retropulsion; is quite intelligent and apt in answering questions; cranial nerves normal; speech monotonous. *Arms:* Fine tremor of hands, right > left; increase of tonus in left arm and voluntary movements tend to be slow; some loss of power. Reflexes: supinator, right and left 0; biceps and triceps, right and left +; co-ordination good; no sensory changes. *Legs:* Increase of tonus in left leg and loss of power; reflexes: knee-jerks—right and left + +; ankle-jerks: right and left +; plantar—right flexor; left ? extensor; no sensory changes; co-ordination good. *Heart:* Normal; blood-pressure, 145/70 mm. Hg. *Lungs:* Normal.

A Case of Post-Encephalitic Parkinsonism (without History of Encephalitis).

By A. Feiling, M.D.

Male, aged 18. Six months ago he noticed that his head began to droop forward and that his movements began to be slow; later, saliva began to dribble from his mouth and his feet knocked together when walking.

Typical appearance and gait of Parkinson's disease; no ocular changes; marked sialorrhœa; some rigidity of all limbs; no alteration of reflexes; only slight tremor.

Case of Multiple Neuritis. ? Post-Diphtheritic, ? Syphilitic.

By A. Feiling, M.D.

J. B., aged 30, was admitted to the Willesden Isolation Hospital on August 19, 1925, with diphtheria. The attack was severe, with mania; the speech was stammering and the tongue tremulous, but the knee-jerks were preserved and there was no affection of the eye or of the palate. He was discharged from hospital on September 19, and it was then recorded that the knee-jerks were present.

[1] Clinical Meeting held at the Hospital for Epilepsy and Paralysis, Maida Vale, January 14, 1926.

On October 24 he began to suffer with pins and needles in the hands and feet (9½ weeks after the onset of the diphtheria). Weakness of the hands and feet followed. These symptoms were preceded by the appearance of a small abscess on one toe which was opened and soon healed.

On admission to hospital on November 17 the signs were as follows:—Definite motor weakness of all four extremities but especially of the distal joints; no actual paralysis of any movement and no foot-drop. Loss of the tendon reflexes in both arms and both legs. Flexor plantar responses. Distinct blunting of sensation to pin-prick and to light touch over the right hand and both feet; some diminution of vibration sense in the feet and lower parts of the legs. No ataxia. No affection of any of the cranial nerves.

Wassermann reaction in the blood positive (twice performed).

Cerebro-spinal fluid.—No excess of cells or of globulin; albumin present in excess; Wassermann reaction negative. Colloidal gold curve 5555542000 (syphilitic curve).

Great improvement has taken place; the knee-jerks have reappeared but the ankle-jerks are still lost. Treatment has been by mercury and iodide by the mouth, and intravenous injections of novarsenobillon.

Case of Double Optic Atrophy with Cerebral Agenesis.

By A. Feiling, M.D.

Male child, aged 2 years, 2 months. Was brought to hospital in January, 1925, because "he seemed nervous." A full-term child and a normal labour. Weighed 8½ lb. at birth and was breast-fed up to 9 months. Two other children in the family, both normal. No miscarriages. Mother appears healthy. Father suffers "with nerves from the war."

In January, 1925, was well nourished and well grown. Was quite unable to sit up and took no interest in surroundings. Head measured 17 in.; the fontanelle was closed. Did not seem to see properly. Examination of the eyes under an anæsthetic (Mr. Williamson-Noble) showed that both discs were greyish-white in colour, the blood-vessels of fairly good calibre. Some retinal atrophy.

Hearing was normal. Voluntary movements of all four limbs actively performed. No abnormality of the reflexes. Wassermann reaction in the blood negative.

Since January, 1925, no improvement. Child is still unable to talk, to walk, to stand or even to sit up unaided. Is quite blind; constant nystagmoid movements of both eyeballs. No evidence of any actual paralysis of the limbs.

Case of Disordered Respiratory Rate and Involuntary Crying; After-effects of Epidemic Encephalitis.

By W. G. Wyllie, M.D.

The patient, a girl, aged 13, had an illness eighteen months ago with insomnia and headaches, and appeared to make a good recovery. The present attacks have occurred in the last six months with increasing frequency. They consist of a short period of rapid shallow breathing, often followed by loss of consciousness with tonic contraction of the limbs and ending with a brief spell of crying.

No oculo-motor palsies are present and the reflexes are normal. Between attacks she is mentally alert. There is considerable emaciation.

Case of Paraplegia with Cerebellar Defect in a Child of Syphilitic Parents : Sister Exhibiting Nystagmus, Bilateral Pes Cavus and Arthritis of Hip : Wassermann Reaction Negative in both Patients.

By W. Russell Brain, M.D.

A. S., aged 18, has noticed for four months dragging of the left lower limb which was followed later by weakness of the left upper limb, dysarthria, diplopia and difficulty with micturition.

Family History.—The parents were married in 1891. The father died in 1914 in Long Grove Mental Hospital of general paralysis ; the Wassermann reaction being positive in the cerebro-spinal fluid. The mother, in 1896, developed a disease characterized by rash and sore throat for which she attended Fulham Infirmary and which she was told was syphilis. The nature of her treatment is not known. She has irregular pupils with a brisk but ill-sustained reaction to light, slight ptosis of the right upper lid, a slight right hemiparesis, with increased tendon-jerks, absent abdominal reflexes and an extensor plantar response on the right side; her blood Wassermann reaction is negative.

The following children were born before the mother's illness :—(1) female, died, aged 9 months, of convulsions ; (2) female, 31, when examined was found to have nystagmus to right and left, but no other evidence of nervous disease ; (3) female, 28, alive and well ; (4) male, died, aged 9 months, of convulsions. After the mother's illness (5) (6) (7) (8) and (9), still-births ; (10) male, 20, alive and well ; (11) A – 18, and (12) E – 14, the present patients ; (13) female, 8, alive and well. Apart from the father no known relative has suffered from any nervous disease.

Present Condition.—Patient is somewhat undersized, with fine dark hair. The bridge of the nose is a little depressed ; the teeth are normal. He is rather unintelligent and emotionally facile ; speech is slurred. There is slight pallor of the temporal half of the left disc, but otherwise the fundi are normal. The pupils and pupillary reactions are normal ; the ocular movements are full ; there is coarse nystagmus on lateral fixation to right and left ; no squint, diplopia, or ptosis. There is slight weakness of voluntary movement of the right side of the face ; the movements of the soft palate and tongue are normal. There is some loss of voluntary power in both upper and lower limbs, more marked on the left side than on the right. Tone is diminished in the left upper limb, but increased in the extensors of both lower limbs. Incoördination is present in all four limbs, more marked on the left side than on the right and in the lower than in the upper limbs. The tendon-jerks are all exaggerated ; there is bilateral ankle clonus ; the abdominal reflexes are absent, and there is a bilateral extensor plantar response. There is no anæsthesia, analgesia or loss of postural sensibility or appreciation of vibration. No talipes. The gait is ataxic and spastic ; Romberg's sign is present. The blood Wassermann reaction has been negative on two occasions. Examination of the cerebro-spinal fluid shows 4 cells per c.mm., total protein 0·120 per cent. ; Nonne-Apelt positive, Lange 4444443310 ; Wassermann reaction negative.

E. S., aged 14, sister of the former patient, has suffered for a few weeks from pains in the left elbow and the left leg. She exhibits no abnormality of the central nervous system except nystagmus on extreme lateral fixation to right and left, more marked to the left than to the right. The teeth are normal. There is bilateral talipes equino-varus with some contracture of the calf-muscles. There is some limitation of flexion and extension of the left hip with pain on passive movement of this joint and ¼ in. shortening of the left leg. A radiogram shows in both hips

"a patch of erosion at the inner end of the epiphyseal line of the femur." The blood Wassermann reaction has been negative on two occasions. Examination of the cerebro-spinal fluid shows 2 to 3 cells per c.mm., total protein 0·025 per cent., Nonne-Apelt negative, Lange 0001114300, Wassermann reaction negative.

Case of Hemiplegia with Epileptiform Convulsions; exhibiting Tonic Innervation and Tonic Neck Reflex of Magnus and de Kleijn.

By W. Russell Brain, M.D.

R. L., aged 40, attended the National Hospital, Queen Square, in 1899, under Dr. Bastian, on account of headache, vomiting and epileptiform convulsions. He was found to have slight papillœdema, nystagmus to right and left; slight weakness of the right grip; incoördination in both upper limbs, more in the left than the right; absent abdominal reflexes on the right side and a right extensor plantar response. A decompression was done on the right side and the dura mater was incised. His general condition was much improved and the papillœdema subsided. He later developed a progressive left hemiplegia and continued to suffer from generalized epileptiform convulsions, of the approach of which he gets no warning.

Present Condition.—Intelligence fair; no dysphasia or dyspraxia. Slight bilateral secondary optic atrophy; vision good, fields of vision full; pupillary reactions and ocular movements normal; weakness of voluntary movement of the left side of the face, soft palate and tongue.

Tonic innervation.—There is considerable loss of voluntary power in the left upper limb; moderate loss in the left lower limb. There is marked delay in initiating movements, each movement beginning feebly but slowly increasing in power. After the patient has fully flexed the fingers of the left hand he can extend them only very slowly, complete extension taking fifteen seconds or longer to accomplish. Involuntary movements of flexion of the fingers sometimes occur.

Tonic neck reflex of Magnus and de Kleijn.—There is hypertonia of the flexors of the left upper limb and extensors of the left lower limb. The tone of the flexors of the left upper limb is increased by rotation of the head to the right, and diminished by rotation of the head to the left.

The tendon-jerks are brisker on the left side than on the right, and the flexor upper limb reflex is obtainable on the left side. The right plantar-reflex is flexor, the left, extensor. There is relative hemi-anæsthesia and hemi-analgesia on the left side with loss of tactile discrimination and complete astereognosis in the left hand. Postural sensibility is grossly impaired in the fingers of the left hand and slightly in the fingers of the right hand and the toes of both feet.

A radiogram of the skull shows a large area of bone defect in the right fronto-parietal region. The blood Wassermann reaction is negative.

Case of Diplegia—Mental Defect—Retinal Disturbance.

Shown by Macdonald Critchley, M.D. (for S. A. K. Wilson, M.D.).

Family History.—Mother and father are alive and well and of healthy stock; they are first cousins. There have been nine pregnancies:—

(1) Girl, 30, alive and well. Married, two children, alive and well; (2) girl, died at 26, with "creeping paralysis"; no blindness or mental defect; (3) girl, 25, blind from birth; no mental defect or paralysis; (4) girl, 22, very anæmic; (5) girl, died in infancy with convulsions; (6) boy, 18, alive and well; (7) patient; (8) boy, 13, alive and well; (9) boy, 11, syndactyly of toes.

Patient, aged 15, was backward in cutting his teeth, walking, &c. Apparently blind since birth. A year ago his legs became weak. Is very backward at school, and has never been able to learn Braille. No fits. Low, narrow forehead; malformed and prominent ears; high-arched palate; cyanosis of extremities; syndactyly of second and third toes of both feet; incurving of little finger.

Ophthalmoscopy reveals gross pigmentary disturbances in the retina, the macula of the right eye being markedly affected. Discs pale and vessels diminished in calibre.

Motor power diminished in legs, with increase of tonus. Bilateral pes cavus with extensor plantar responses. Wassermann negative.

Case of Syringobulbia.

Shown by MACDONALD CRITCHLEY, M.D. (for F. M. R. WALSHE, M.D.).

THREE years ago: sudden onset of numbness down the left side, associated with muscular weakness. Nine months ago: giddiness and staggering whilst walking.

Nystagmus on lateral ocular deviation especially to the left. Some weakness of the left masseter. Paralysis of left side of palate and left vocal cord. Tongue shows marked left-sided hemiatrophy. Slight left-sided hemi-anæsthesia to all forms of sensation. Slow athetoid movements of left hand and foot. Relative weakness of all voluntary movements on that side together with intention tremor. Tonus somewhat increased, and there is some wasting of the left arm and leg. Tendon jerks, left brisker than right; left abdominal reflex absent. Left plantar response is extensor in type. Blood-pressure 140/115. Wassermann reaction negative.

Von Recklinghausen's Disease in Three Generations.

By W. J. ADIE, M.B.

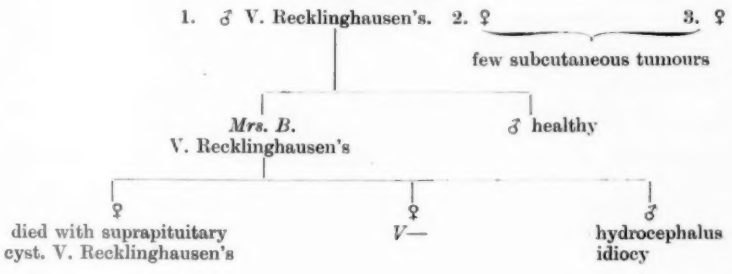
(1) MRS. B., aged 35, multiple subcutaneous nodules noted since the age of 25: one tumour on the scalp noted since she was 10. She has had brown patches over the body since birth.

(2) V— B., aged 9. Admitted for enlargement, increasing adiposity, and giddiness. No subcutaneous nodules present but many cutaneous pigment patches. Examination of fundi shows swelling superimposed upon an atrophic disc: sella turcica enlarged. Blood and cerebro-spinal fluid normal.

Family History.—Maternal grandfather has generalized von Recklinghausen's disease. His two sisters each had one or two subcutaneous tumours. Two children: Mrs. B., von Recklinghausen's disease; one son, healthy.

Mrs. B. has had three children: (1) L., died last year, aged 10, with a suprapituitary cyst. Had many pigmented patches and subcutaneous tumours; (2) V.; (3)

FAMILY TREE:—



Korsakow's Syndrome with Double Sixth Nerve Palsy due to Alcohol.

By Douglas McAlpine, M.B.

E. A. W., FEMALE, aged 32, admitted to Maida Vale Hospital on October 30, 1925. For some months prior to admission she had been consuming large quantities of whisky. In September, 1925, she first complained of cramp-like pains in the legs. Her medical attendant found the deep reflexes in the legs brisk. She was persuaded to reduce her intake of alcohol considerably. On October 6, whilst out shopping her legs gave way and she fell. She managed to reach home and went to bed. The following day she complained of double vision. When seen on October 12 she showed definite paresis of both sixth nerves, mental symptoms, and absent deep reflexes in the legs, but very little loss of power in the legs.

On admission (October 30).—Gross loss of memory, especially for recent events; loss of emotional control; hallucinations. Paresis of both sixth nerves almost complete. No facial weakness. Upper limbs showed coarse tremor; slight paresis peripherally and a glove form of anæsthesia with loss of postural sensibility in fingers. Lower limbs, peronei affected with paresis, but tibialis anticus on each side quite strong. Marked tenderness of lower limbs on palpation. Deep reflexes absent. Stocking anæsthesia with loss of postural sensibility. Marked myocardial weakness, incontinence of urine and fæces.

Progress.—Paralysis in legs progressed until no movement of toes or ankles was possible. Paralysis of both sixth nerves gradually disappeared. Present condition (January 11, 1926): Mental condition much improved, sphincter control almost normal, and power is beginning to return in the toes and ankles.

Case of Intramedullary Tumour of the Cord Removed by Operation.

By Douglas McAlpine, M.B.

D. L. H., MALE, aged 21, first noticed a weakness of left hand and wrist in January, 1925, which progressed so much that by July he was scarcely able to lift the arm above the level of the shoulder. In September weakness of left leg appeared. Deep X-ray therapy to lower cervical region from beginning of October to end of November. Condition progressed, however, so that he was admitted to Maida Vale Hospital on November 28. No history of pain throughout.

Condition on Admission.—Left palpebral fissure and left pupil smaller than on right side; left pupil dilates on shading less well than the right. Remaining cranial nerves normal. No weakness of sterno-mastoid or trapezii. Complete flaccid paralysis of left arm, with marked generalized wasting. Abolition of deep reflexes of left arm. No wasting or impairment of power in right arm. Reflexes brisk. Abdominal reflexes absent left side; 15-20 per cent. loss of power in left leg. Deep reflexes increased, left leg. Left extensor plantar response. Right plantar flexor. Sensation: dissociated anæsthesia of left arm and trunk (see charts). Some impairment of sensation on inner aspect of right arm. No sphincter disturbance. X-ray lower cervical region negative. Cerebro-spinal fluid faintly yellow; 9 cells per c.mm. Total protein 0·35 per cent. Wassermann reaction negative.

A diagnosis of tumour of the lower cervical cord, probably intramedullary, was made.

Mr. Bankart performed laminectomy on December 17 and removed laminæ of fourth to seventh cervical vertebræ. An intramedullary tumour was found with its centre about seventh segment, extending up and down the cord for several segments. The cord was incised in the postero-median line and a piece of tumour removed.

Histological Examination.—Glioma.

Patient has made a good recovery from the operation. Condition remains about the same except that there is now an early extensor plantar response on the right side and a general blunting of all forms of sensation on the left leg. The right arm is now slightly affected with paresis. It is proposed to give further deep X-ray treatment.

Case of ? Distal Myopathy.

By C. WORSTER-DROUGHT, M.D.

F. C. L., AGED 37, first seen in November, 1917, at the age of 29.

History.—From the age of 18 he had served in the Army as a cavalryman and had had no previous illnesses. During 1916 he began to complain of weakness of both legs, and of great difficulty in holding urine. Later his legs wasted below the knees and frequent urinary incontinence occurred. In December, 1915, he had sustained a fall from his horse, but the above symptoms did not develop until several months after this accident.

Family History.—There is nothing of note.

Physical Examination. — The muscles of both calves are equally wasted (circumference measurement of shank 10½ in.) and are very deficient in power; he is unable to rise on the toes. Tibialis posticus, tibialis anticus, peronei, extensors and flexors of toes, quadriceps and hamstrings all show good power. No fibrillary twitchings observed. Gastrocnemii respond very sluggishly to faradism and react only on No. 12 stop of the Lewis-Jones condenser (normal stop No. 4). The ankle-jerks are absent, but the knee-jerks are brisk and equal, and abdominal and plantar reflexes normal. Sensation everywhere normal. The remainder of the nervous system and other systems show no abnormality. Cerebro-spinal fluid normal, and yields a negative Wassermann reaction; blood also negative. X-ray examination of the spine in the lumbar region and the pelvis reveals no abnormality.

During the past eight years his condition has altered very little. The partial urinary incontinence persists, and there is some precipitancy of defæcation; the muscular atrophy remains limited to the gastrocnemius-soleus on each side. These muscles no longer react to faradism, and respond only very sluggishly to galvanism, A C C being greater than K C C.

At the end of 1917 the late Dr. F. E. Batten saw this case with me and was of the opinion that it was an example of the type of myopathy known as "distal myopathy." Somewhat against this view, however, is the presence of incontinence, and the fact that in the cases of distal myopathy that have been described (Oppenheim and Cassirer, Gowers, Dejerine and Thomas, Batten, Spiller and Naville) the extensor muscles are early, and chiefly, affected. Also, if accepted as a case of distal myopathy, the question arises whether it is one of the very rare examples in which arrest has occurred.

On the other hand, the absence of any sensory abnormalities throughout the course excludes a cauda equina lesion, while the age of onset, the distribution, the absence of fibrillary tremors in the atrophied muscles, and the fact that the condition has remained stationary during the past eight years, does not favour the diagnosis of a myelopathy.

Case of Functional Paraplegia, with Complete Incontinence of Urine. Mitral and Tricuspid Stenosis.

By Wilfred Harris, M.D.

Patient, a male, aged 32, discharged from Army in August, 1917, with V.D.H.

Was quite normal as a boy, and able to play games as well as others. At the age of 18 he had an attack of subacute rheumatism, and was laid up for five months. In July, 1917, was seized with vertigo, later becoming unconscious; was very cyanosed at that time. From 1919 to 1923 was able to work as travelling auditor in the employ of one of the Ministries. Collapsed twice; in December, 1922, was unconscious for twelve hours. In June, 1923, gradually began to lose control of his legs, had pain like pins and needles in his spine, and his legs used to give way. Loss of bladder control also appeared about this time; he used to wet his clothes and the bed, and had to wear a rubber urinal. On several occasions there was free hæmoptysis. Legs have gradually got worse so that now he cannot stand.

Present State.—Legs thin, but no muscular atrophy. Knee- and tendo Achillis jerks normal, plantars flexor. Light anæsthesia of feet and legs up to the groins. Abdominal reflexes brisk. Anal sphincter reflex brisk. No difficulty in controlling the bowels, but dribbling incontinence of urine. Is considerably cyanosed; fingers slightly clubbed. Vibratory cardiac sounds suggestive of mitral stenosis.

Mentally the man is active and well educated, and considerably above the ordinary hospital class.

Section of Neurology.

President—Dr. H. Campbell Thomson.

DISCUSSION ON THE SYMPATHETIC INNERVATION OF STRIATED MUSCLE.

Dr. E. D. Adrian.

We must all feel to-night a sense of misfortune unusual in a scientific discussion. I do not really refer to the tragic deaths of Hunter at the outset of his career, and of Kulchitsky, whose work was so closely connected with Hunter's. We shall be paying the best tribute we can to these scientists if we discuss their work and the theory that was evolved from it in a scientific way, and that is the most cold-blooded way possible. But even if we succeed completely in forgetting the larger issue, the loss to science in general, we have still the very real misfortune that the protagonists are not here to-night to state their views and to answer criticism. I, for one, feel that the theory which Hunter left behind him does not really do him justice. It has grown out in many directions, but the inevitable process of pruning has not begun, and we are all in danger of making it out too definite and of assuming that it must stand or fall as a whole. As a matter of fact the points which are really in dispute are not so much points of theory as of experiment; but the theory is an important one and it is high time that it should be discussed.

To clear our minds I think it will be as well to recognize that there are two distinct topics which will come up. Hunter and Royle put forward, or at any rate put new life into, a theory of the sympathetic control of the tonic contraction of muscle, and they also described an operation, based on their theory, which they claimed would benefit the spasticity of certain forms of paralysis. We have to consider both whether the theory is right and whether the operation is successful, and one may be right without the other.

My own function is the simple one of reviewing as briefly as possible the physiological views which have already been published on the connexion of the sympathetic system with the tonic contraction of muscle. I am, unfortunately, in the unassailable position of having done no work on the subject myself; I have worked with decerebrate animals, but the only first-hand impression I have about tone is that it is an extremely difficult subject to investigate.

Before Hunter and Royle began their work, the position was as follows: Boeke, in 1909, described a system of accessory non-myelinated nerve-fibres in striped muscle. He found that these nerves supplied muscle-fibres which were also innervated by medullated nerve-fibres. They did not degenerate when the anterior roots were cut, and they appeared to belong to the sympathetic system. He confirmed this with Düsser de Barenne, and other workers agreed with him.

There seems to be no doubt now that these independent non-myelinated fibres do exist in certain muscles, that they supply some of the muscle-fibres, and that they do not belong to the cerebro-spinal system. The points that are doubtful are: (1) Whether they exist in every muscle; (2) whether they supply a special type of muscle-fibre which is not innervated by medullated nerves. These points have been reviewed very clearly in a recent paper by Garven, in *Brain*.[1] As regards (1), the

[1] *Brain*, 1925, xlviii, pp. 380-441.

position seems to be that in most muscles the accessory nerve-fibres exist, but in the muscles of a frog they have not yet been demonstrated as ending in the muscle-fibres themselves. (2) Do the accessory fibres supply a distinct type of muscle-fibre not innervated by medullary motor-fibres? This does not seem to me to be of crucial importance from the more general point of view as to whether the accessory nerve-fibres have a tonic function or not. But it is a part, though not, I think, an essential part, of Hunter and Royle's theory, that the sympathetic fibres innervate separate muscle-fibres of the "red" or narrow sarcoplasmic variety which have no supply from the cerebro-spinal system. This view was based on some of Kulchitsky's work, but at present all the evidence seems to be against it. Garven has made a very careful investigation of the muscles of the hedgehog and finds no clear separation into two distinct kinds of muscle-fibre; he found that medullated nerve-fibres end in every type of muscle-fibre. Some muscle-fibres are innervated both by the accessory and the medullated fibres. From this very convincing new evidence it seems clear that this part of Hunter and Royle's theory is untenable. It is no great loss, for there were many other difficulties to be faced apart from the histological evidence. But although the theory of a separate system of tonic muscle-fibres with a separate nerve supply is untenable, it is still quite possible that the same muscle-fibre may react differently to the two sets of nerves. This brings us to the physiological evidence.

As soon as the existence of the accessory non-medullated nerve-fibres had been demonstrated, it was natural that various attempts should be made to discover their function, and the most likely possibility seemed to be that they were associated with tonic contraction. Whether or no there are really two fundamentally distinct kinds of contraction, we can at least distinguish two very different ways in which a muscle can behave. It may perform a series of rapid phasic movements, or it may hold the limb in a definite posture by the steady contraction which we speak of as "tonic." In the former case a great deal of energy is used up, the gaseous exchange is large, and the muscle fatigues readily. In the latter there is little fatigue, and there seems no doubt that the metabolism is much smaller, and much smaller than it would be if we produced a corresponding steady contraction by tetanizing the nerve. These two different kinds of behaviour are really at the opposite ends of a scale and a sharp distinction between them may be artificial, but in some invertebrates, e.g., bivalves, the distinction is real. In these animals there is no doubt that the two reactions are really carried out by two very different muscles or muscle-fibres. Thus we might well expect to find two distinct mechanisms in the vertebrates as well.

The classical example of the tonic contraction in a mammal is the state of decerebrate rigidity, Sherrington's "reflex standing," and after the discovery of Boeke's fibres many investigations were made to see if ablation of the sympathetic system had any effect on decerebrate rigidity. Van Rijnberk, Cobb, and Düsser de Barenne made this experiment in cats, and none of them obtained a positive result. In some animals destruction of the sympathetic on one side produced a decreased tone, but in many it did not, and the negative result is more significant than the positive. We may call this the classical experiment, and it has remained the most important method of investigating the problem. However, de Boer and Langelaan did not accept these results as final, and sought in other ways to demonstrate a connexion between tone and the sympathetic. De Boer's work on frogs has been severely criticized, and it does not really account for the failure of the classical experiment. Langelaan made a new step by splitting up the conception of tone into two: contractile tonus and plastic tonus or plasticity. These conceptions have had a good deal to do with the theory we are discussing, but as a matter of fact most of Langelaan's readers seem to have got as far as the two terms, contractile tonus and plastic tonus, and then put their own interpretation on them. At any rate, according

to Langelaan's definition, an increase in plasticity means not that the muscle develops a greater resistance to a change in its length, but that it becomes more plastic, that it is extended more rapidly by a given weight. This seems to me to be a different conception from the plastic tone of Hunter and Royle, though whether it is more or less valuable is another matter.

The position, therefore, when Hunter and Royle began was that the classical experiment on decerebrate rigidity had failed to show a sympathetic influence, and other lines of experiment had been equally inconclusive. Hunter and Royle's work may be divided into three categories: (*a*) a repetition of the classical decerebration experiment on goats; (*b*) experiments on birds; and (*c*) experiments on man. They found that if in goats the sympathetic was destroyed on one side some time before decerebration, there was a distinct difference in the behaviour of the two hind limbs: that on the affected side took up the extended posture given it, but did not retain it as long as the limb on the sound side. Hunter and Royle looked on this as a sign that plastic tone was reduced, plastic tone in their sense being the property which is responsible for the maintenance of any posture which the muscle has assumed, and they put forward their theory that this particular kind of tone is directly controlled by the accessory sympathetic fibres in the muscle. Now, it is obvious that this result is something quite different from the earlier results with the decerebrate experiment. Hunter and Royle describe differences in the two limbs too great to have been overlooked by the experienced physiologists who preceded them. It is true that Hunter and Royle were using goats instead of cats; but the most significant difference seems to be that in Hunter's experiments the decerebration was done some time after the destruction of the sympathetic. Some of van Rijnberk's experiments were made in the same way, but at any rate the lapse of time is the point which distinguishes Hunter and Royle's goat experiments from most of the earlier work.

Why should it matter whether the sympathetic is destroyed a short or a long time before the decerebration? Or rather, if the sympathetic is responsible for plastic tone, why should there be no loss of plastic tone immediately after the limb is deprived of its sympathetic supply? Why should we have to wait for some months before the effect becomes visible? The most natural suggestion seems to be that the loss of the sympathetic does not produce a loss of the nervous impulses which are the immediate cause of tone, but it produces a loss of some trophic factor without which the muscle cannot carry out the tonic reactions so easily. Such an effect might be a direct one on the muscle-fibres or an indirect one on the blood-vessels.

But here, too, it is not so much the theory as the facts that are in dispute. There is considerable doubt even about the delayed sympathetic effect. Meek and Crawford have recently carried out unilateral sympathectomy on dogs and have decerebrated them from thirty-three to seventy-seven days afterwards. Most careful tests were made to detect differences of tone in the two limbs but no significant difference was found. Kananel, Pollocks and Davies have repeated the classical experiment on cats and they again have found no significant difference. Some of these contrary results might perhaps be explained by the suggestion that the plastic tone was masked by an excessive contractile tone, but it is difficult to see how this can apply to Meek and Crawford's work, and difficult to understand what is meant by plastic tone if the fixed posture of decerebrate rigidity can be maintained without it. We must conclude, then, that this delayed sympathetic effect does sometimes occur, at any rate in goats, though it is usually absent in dogs and cats.

Hunter's experiments on birds are more difficult to evaluate. They have been criticized by Walshe on the basis of Trendelenburg's work, and this criticism seems valid enough. But even if we grant that removal of the sympathetic has a more immediate effect on the posture of the bird's wing than it has on the posture of decerebrate rigidity in a cat or a dog, I do not think that we can conclude anything

more than that the effect of sympathetic loss does develop more rapidly in birds than in mammals. We have no reason to conclude that there is an *immediate* loss of plastic tone in mammals.

On the experimental side, then, the balance of published evidence seems overwhelmingly against the view that the sympathetic sends out impulses which have a *direct* controlling effect on posture, the length or the plastic tone of the limb muscles, an effect comparable to that of the cerebro-spinal impulses.

But I do not think the experimental work is enough to allow us to assert or to deny that in most mammals the removal of the sympathetic may ultimately lessen the power of the muscle to maintain a fixed attitude. If this were clearly demonstrated it would at least show some connexion between the sympathetic and tonic contraction. The sympathetic would be playing a very much less active part in the control of the muscle than Hunter and Royle suggested, but it would be playing a part of some kind. It is here that the operation of sympathetic ramisectomy may furnish evidence of value.

Hunter and Royle deserve very great credit for devising this operation. It introduced a new method of attack on the physiological problem, and it was well worth trying from the patient's point of view as well as the surgeon's and the physiologist's.

Everyone here is probably familiar with this side of their work and with the discussion which has centred round it. Hunter and Royle considered that in cases of paralysis with an excessive plastic tone the operation of sympathetic ramisectomy did produce very great benefit indeed. Others have tried the operation and pronounced it a complete failure. Fortunately we have those present here to-night who will be able to tell us their own experiences of the operation. There are only two points about this side of the problem with which I wish to deal. The first is that it was not claimed for the operation that it would benefit all cases of spastic paraplegia, but only those in which increased plastic tone is a dominant feature. As I understand it Hunter and Royle considered that a rigid posture of the limbs with increased tendon reflexes and an extensor plantar response might all exist without any increase in plastic tone. The indications which Hunter gives are first the "lengthening and shortening reactions," the fact that the resistance to passive flexion or extension is at first considerable and then subsides suddenly. I cannot quite follow the argument here, since both kinds of tone are said to produce resistance to movement. The other indication is a slowness in execution of the tendon-jerks, or rather delayed relaxation. This narrows the field considerably and may account for some of the failures.

The other point is that the success of the operation would not necessarily imply a direct control of changes in length of the muscle by the sympathetic system. An immediate reduction in tone would certainly suggest this, were it not for the failure of so many of the animal experiments; a delayed effect would be much more likely to be due to some indirect consequence of the sympathetic removal, though it would be none the less gratifying to the patient and none the less worth aiming for. In this audience one need not stress the importance of distinguishing the effects of the operation on the patient's mind from the effects on his body.

In Royle's first case one cannot help feeling that the organic symptoms were overlaid by a good deal that was functional. However, enough time has now elapsed and enough operations have been done to allow us to make a fair estimate of their value, and I am very glad that we shall have the opportunity of hearing first-hand evidence on it to-night.

Professor G. Elliot Smith, F.R.S.

It is hardly necessary to insist upon the difficulty of arriving at any definite opinion on the claims for the sympathetic innervation of striated muscle. Nor is this

altogether surprising when one considers that for nearly half a century both histologists and physiologists have in vain been wrestling with the problem. The extensive literature on the subject has been critically examined by Wilson [13], by Spiegel [10], by Hunter [6], by Cobb [2], and Walshe [11], so that it is unnecessary to deal with the history of opinion.

I would not attempt to deal with this contentious subject if it were not for the following facts: First, in 1924 I saw the animals upon which Hunter had experimented in Sydney, and at present I have in my possession the cinematograph films that faithfully record these experiments; and secondly, during the last four years several investigators have been working in the Department of Anatomy at University College on the questions at issue.

In this discussion I shall avoid the use of the terms "plastic" and "contractile" to suggest a differentiation of tone into two categories. I shall also, as far as possible, avoid the use of the word "tone" itself. It will suffice if we speak of the two types of muscular activity that are well recognized in the case of invertebrate animals, namely, the execution of movement and the maintenance of posture.

The fact that invertebrates are provided with two sets of muscles—one for effecting movements and the other for maintaining posture—does suggest the probability that the more highly-developed muscular apparatus of vertebrates may be at least as well equipped for their work as those of a mollusc.

No one who has seen a goat deprived of the lumbar part of its sympathetic cord could entertain any doubt as to the profound influence of the operation on the corresponding hind limb. When placed on its back all four limbs at once go into the defensive attitude of extension (and of course even more markedly in the decerebrate animal); but the leg devoid of sympathetic soon tires and falls into a position determined by gravity.

Some experimenters have recorded analogous phenomena in other mammals, cats, dogs and rabbits; but have discounted these results because they failed to obtain them in all cases. Ducceschi [3] called attention to the striking loss of tone in the rabbit's ear after section of the cervical sympathetic.

The experiments that Hunter carried out on birds are of special interest. In the bird the sympathetic fibres to the wing are connected with the spinal cord *below* the brachial plexus, so that it is possible to cut either the somatic or the sympathetic fibres to the wing without interfering with the other set. The seagull is a bird that is distinguished above almost all others by exceptional powers of endurance in flight, for the natural conditions of its life demand that it should be able to remain on the wing for many hours at a time. Yet a seagull, deprived of its sympathetic innervation, but with the somatic innervation intact, will be so completely fatigued after a flight of 100 yards that the wing on the affected side will drop down in an entirely flaccid condition after this very slight exercise. This affords the most positive demonstration that could be desired of the influence of the sympathetic in the prevention of fatigue as well as of loss of tone. Whatever view be taken of the relation of the sympathetic system to the muscles of the wing this fact calls for some explanation. Orbeli and his colleagues claim that the sympathetic system plays an important part in the activity of skeletal muscle by preventing fatigue, and that the phenomenon cannot be explained as being due to a disturbance of the circulation.

Working in the late Professor Langley's department, Dr. Helene Wastl [12] failed to obtain any confirmation of the Leningrad results. Nor were Huggett and Mellanby [5] able to demonstrate any influence of the sympathetic or of adrenalin on striated muscle.

The results obtained by Hunter in his experiments on the seagull were, however, quite definite and unmistakable, and confirm Orbeli and his school in so far as they claim an influence for the sympathetic in preventing fatigue.

If it be admitted that the sympathetic exerts an influence upon the function of

striated muscle, it follows as a necessary inference that sympathetic nerves must have some connexion with such muscle. The problem then arises as to the nature of the connexion.

Boeke and his collaborators claim that every striated fibre has both a somatic and a sympathetic fibre connected with it. Careful study of his own statements, however, especially in the light of the observations made by Kulchitsky, suggests that a considerable proportion of the non-medullated fibres may be collateral branches of the ordinary medullated nerves. But the degeneration experiments, especially Agduhr's, seem to have provided definite evidence that, after excision of the sympathetic ganglia, a certain number of degenerated fibres are found ending in striated muscle. It was to get further information on this important issue four years ago that we suggested to Professor Kulchitsky the desirability of re-examining the whole question. But his laborious investigations, carried on for three years, still leave the matter in doubt. One is bound to admit that no complete solution has yet been found of this difficult problem. He confirmed the observations made by his predecessors during the last forty years that there were two definite types of nerve-endings on striated muscle, in addition to the non-medullated nerves ending between the bundles of muscle-fibres and the well-authenticated afferent medullated nerves from muscle spindles. The first of these categories are the ordinary muscle-plates connected with medullated somatic nerves. It is with regard to the second type of endings that the difficulty arises. The second variety consists of the grape-like terminations connected with non-medullated nerves. In spite of the fact that he regards them as epilemmal, Kulchitsky called them "motor-endings." Perroncito, however, regarded them as hypolemmal. If they are epilemmal the question arises whether they may be afferent in function, as Bremer suggested in 1882. But we know so little of the mode of action of nerve on muscle as to make it unjustifiable to assume that an epilemmal ending may not be part of an efferent nerve. In support of the view that they are efferent it is important to remember that upon the slender granular muscle-fibres in Kulchitsky's preparations no other possible effector nerves have been found except the non-medullated fibres with the grape-like endings. In his preparations, treated with gold chloride, of the muscles of goats and fowls used in Hunter's and Royle's experiments, Dr. Oliver Latham came to the conclusion that the slender muscle-fibres were provided with both hypo- and epi-lemmal endings of non-medullated nerves. After studying his preparations, which are much better than his somewhat crude drawings [8] would lead one to suppose, I am bound to confess, that his evidence, though suggestive, is not altogether adequate to sustain his claims.

Dr. H. H. Woollard has recently made a series of extraordinarily beautiful preparations of striated muscles of the cat and rabbit stained with methylene blue. He has not yet published an account of his investigations, but has kindly permitted me to refer to them. He failed to discover a second type of nerve-ending in connexion with striated muscles; but in the extrinsic muscles of the eye (though not in other muscles) he found a veritable forest of non-medullated nerves ending in the connective tissue between the muscle-fibres. So numerous were these fibres that they must represent a considerable proportion of the nerves going to these muscles.

I have already mentioned incidentally a point that is revealed in Professor Kulchitsky's preparations. In all his drawings he showed that the muscle-fibres with endings of the second type upon them are considerably smaller than the coarse fibres with the ordinary end-plates, although in his description he did not refer to the fact that there is this difference. In order to settle this matter I asked Miss Catherine Hill to examine a series of Kulchitsky's slides and record the diameter of the fibres associated with the two types of nerve-endings. After measuring a large number of muscle-fibres she found that those provided with the ordinary end-plates were on the average more than double the size (the proportion was 18·2 to 8·4) of

those with the grape-like endings, which Kulchitsky called "type two." Of course the difference in the type of the nerve-ending may have no other significance than the fact that one type of nerve-ending to a thicker fibre is naturally bigger than that going to the slender fibre. But it is an interesting fact that there should be such a contrast, which involves not only size but also morphological type.

There is the further point that the striation of the thicker muscle-fibres is much more definite than that in the slender fibres and the sarcoplasm much less definitely granular. However, one is bound to admit that the evidence afforded by histology has so far not provided the complete solution of the problem before us.

With the object of settling the question of the independent innervation of the two constituent elements of striated muscles Hunter examined sections of the sartorius in a goat, from which the lumbar part of the sympathetic cord of the same side had been removed six months previously. He compared them with corresponding sections of the muscle in the normal limb of the same animal. In the latter the muscle-bundles were approximately of the same size, whereas in the former some groups of fibres were reduced in size, and others were at least as big as, if not bigger than, the normal. There was also a noteworthy increase in the amount of fibrous tissue. The complementary study was made of the pectoral muscles in the fowl in which the somatic nerves going to one wing had previously been cut. Here again the process of atrophy had affected certain muscle-fibres, but not all. In this case the compensatory increase in the fibrous tissue that seemed to result from sympathetic de-nervation was not revealed.

These results afford perhaps the most definite structural evidence of the differentiation of two kinds of striate muscle.

I will now refer to several points raised by various critics. In the first place Cobb's criticism "that the innervation of the muscles of the snakes may be different to that of mammals" can be met by the positive demonstration of similar appearances in the goat's muscle, prepared by Dr. Oliver Latham in Sydney. Although his preparations made by the gold chloride method lack the clearness of Kulchitsky's slides of the python's and lizard's muscles, they afford adequate proof that the same state of affairs is found in mammals as in reptiles. Moreover, Boeke found nerve-endings in embryonic human muscle similar to those of the lower vertebrates.

In his experiments on goats Hunter found that there were two mechanisms in the hind-brain controlling tone in the limbs, and that both of these centres had to be cut off from their connexions with the spinal cord before complete flaccidity was established. He has summarized these experiments in his Murphy Oration [6]. After decerebration by Sherrington's method extensor rigidity developed rapidly and well. The lateral part of the bulbo-pontine junction was then excised by a crescentic incision (and microscopic examination subsequently proved that Deiters' nucleus had been completely removed and the vestibulo-spinal tract severed by this procedure). But the lengthening and shortening reactions were still exhibited and tone was still present in the limbs. A second section was made of the junction of the pons and medulla. The limbs became flaccid immediately, and the lengthening and shortening reactions were no longer elicited.

This experiment shows quite conclusively that the maintenance of tone in the limbs is not wholly dependent on Deiters' nucleus, but is due to two definite centres, and only completely disappears when both are cut off from the spinal cord. This result has been independently confirmed by Bernis's and Spiegel's experiments on cats [1].

Dr. Walshe's account of what he observed in the fowl operated on by the late Professor Hunter in London differs so profoundly from my own impressions of the examination of a series of birds upon which experimental operations had been made in Sydney, that no useful purpose would be served by discussing this matter until the facts can be demonstrated objectively. I should like, however, to make one comment

upon the statements made by Dr. Walshe. Referring to Hunter's work, he says that he saw a fowl whose posterior cervical roots had been cut in the region of the brachial plexus, and the wing *retained posture only when lying against the bird's supporting side.* (The italics are Walshe's.) He says he had an opportunity of examining such a fowl, and can confirm this observation. He added that "not only was the wing musculature wholly atonic to passive stretching, but it retained the abnormal postures only as determined by gravity."

He quotes Trendelenburg's experiments on pigeons in support of his criticism. But it must not be forgotten that it was Sherrington's discussion [9] of these same experiments of Trendelenburg, and especially his statement, "section of the afferent roots of the wing affects little, if at all, the folded posture maintained by the wing," that prompted Hunter to investigate birds for himself. Walshe's impression of what he saw in Hunter's fowl is not wholly consistent with Sherrington's reference to Trendelenburg's experiments. For the latter does not say that the wing retained posture only when lying against the bird's supporting side, or abnormal postures only as determined by gravity. On the contrary, Sherrington was at pains to discover why postural contraction was not lost, and put forward the hypothesis that it was due "to an allogenous rather than an autogenous influence."

But Walshe pushed his argument further. "It must be remembered," he says, "that such a wing has been wholly deprived of sensibility." It remains passively in any posture given to it (provided it is supported by the body) because "it has been completely cut out from the field of the bird's consciousness."

Hunter's experiments afford a complete answer not only to Walshe's criticism, but also to the point that puzzled Sherrington and led him to seek for some afferent channel other than that coming from the wing, to explain the proprioceptive reflex conferring tone on the wing.

Hunter found that in a fowl (in which the posterior roots of the brachial plexus had previously been cut) section of the sympathetic cord (i.e., the vertebral plexus) at the level of the first thoracic nerve produced complete flaccidity in the wing, so that it did actually obey the force of gravity, but in a very different way from Walshe's conception of how gravity acts. Hence it provided the answer to Sherrington's conundrum by showing that the proprioceptive influences determining tone are in reality autogenous.

There is only one other point in Walshe's criticism to which I shall refer on the present occasion. He omits all reference (p. 445) to the very positive results obtained experimentally by Hunter after excising the bird's corpus striatum.

> "This operation produces rigidity of all the limbs. Standing is not even maintained, due to rigidity of the hind limbs. On this account in seagulls a tendency to rise on the toes is constantly exhibited and the bird does not maintain any given position for long. Birds in this condition often squat down, presumably to avoid balancing on the rigid limbs. The wings are also rigid and here the nature of the rigidity may readily be studied. The wings are sometimes maintained in a position somewhat higher than usual, so that the adjacent borders are almost in contact with one another. The rigidity maintains its intensity during passive movement, and on account of its rigidity the wing remains fixed in the new position assumed. This occurs even though the position be so abnormal, as when the wing is folded over the mid-line of the back, that the fibrous structures contained within are put upon the stretch. Dependent positions [i.e., an active fixation], are maintained equally well. Both wings exhibit this phenomenon after the unilateral operation, but the rigidity is greater on the ipsilateral side. The rigidity is responsible for slowness of movement, especially on the ipsilateral side. This is readily seen on watching the movements of the wing during attempted flight, while the bird is held captive in the hand. A greater effort is necessary to carry the wing through a smaller range of upward movement than on the less affected side; increased effort marks downward movement also, and the wing seems to overshoot the position at which it normally ends. These alterations in the nature of the movement of the wings are greater on the ipsilateral side, so that the flight of such a bird, when released, is always in a circle, the bird tending to fly towards the more affected side.

"This diffuse muscular rigidity is strongly reminiscent, in an exaggerated form, of the condition of the wing already described, in which, after the removal of the contractile tone [i.e., after cutting the somatic afferent nerves], plastic tone is accessible for independent study. I cannot avoid the deduction that increased plastic tone in both flexor and extensor muscles of the wing is responsible for the diffuse muscular rigidity which follows the removal of the corpus striatum in birds. This element of tone is so enormously increased that manifestations of the presence of the contractile component are in the background."

The condition of rigidity of the wings of birds above described is remarkably similar to Parkinsonian rigidity in man. Its diffuseness, resistance to stretching, and the tendency for fixation of the muscle at any length passively imposed upon it, are common to the two conditions; and in both conditions poverty and slowness of voluntary movement, which are probably due in part to the underlying phenomenon of rigidity, are notable concomitants.

Dr. Arthur Hall's recent account [4] of the symptoms of post-encephalitic Parkinsonism reveals a state of affairs singularly like Hunter's experimental results in the bird.

The results of this operation are definite and unmistakable. Walshe does not mention these experiments, but concentrates attention on the speculations of Kappers concerning the morphology of the corpus striatum, unfortunately introduced by Hunter into his arguments [6], which I was careful to omit from the lectures I delivered on his behalf [7]. I am in complete agreement with Walshe's criticism of Kappers' views on this subject; but I fail to understand what relevance the discussion of these speculations has to the real issue relating to the corpus striatum.

To sum up, the one thing that comes out clearly from all this experimental work is that section of the sympathetic nerves does render the appropriate group of muscles much more liable to fatigue than the normal muscle. The muscle that is fatigued as a result of the sympathetic de-nervation becomes definitely toneless.

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Dr. EDWIN BRAMWELL.

I doubt whether anyone is prepared to assert that the possibility of a dual innervation of muscle can be definitely denied, for while some of the observations and conclusions advanced in support of a dual innervation have been severely criticized, such criticism is not necessarily exclusive in relation to the general proposition.

The problem may, I think, be approached from another point of view. We may, for instance, ask, Does the assumption of the dual innervation of muscle as an hypothesis afford an explanation of clinical phenomena which are otherwise difficult to account for? A line of argument of this kind cannot be expected to afford more than suggestive evidence, but it may be none the less interesting. In this connexion I would like, in a few words, to refer to the muscular dystrophies. I may remind you that Landouzy and Dejerine, in 1886, suggested that the nervous system in muscular dystrophy may be altered in a way that we are unable to detect, and that Erb, in 1890, wrote: "I cannot avoid the suspicion that after all the affection may be dependent upon the nervous system." Further, I think I am right in saying that no new data have until recently emerged with a direct bearing on this question since

Erb wrote these lines. The myopathic view has indeed gained ground, since, notwithstanding the introduction of new staining methods, no changes have been found in the nervous system which will explain the symptomatology of muscular dystrophy. This, however, is a negative conception and, as I have pointed out elsewhere, there are certain features met with in muscular dystrophy, too frequent to be accounted for by coincidence, which cannot be explained on the basis of a primary disorder confined to the skeletal muscles. Again, there are certain symptoms, as for instance the marbled appearance of the skin, which are not infrequent and which suggest involvement of the sympathetic system. Then, again, it is interesting to note that contractures are observed in some cases of muscular dystrophy, and that both contractures and vasomotor changes are met with in some cases of acute poliomyelitis, although they do not occur in the progressive muscular atrophies of spinal origin. Further, the changes in the muscle-fibres and interstitial tissue observed in muscular dystrophy are, I think, more easily accounted for by a disturbance of the innervation of these two component structures of the muscle rather than by a primary change limited to the muscle-fibres. Observations upon the histology of the sympathetic fibres and terminals are required before this question can be settled. At the same time the facts to which I have referred raise the possibility that the muscular dystrophies may be determined by disease of the sympathetic system, and are at least suggestive in relation to the question of the dual innervation of muscles.

Mr. A. S. Blundell Bankart

said that he first began to operate upon the sympathetic nervous system in cases of spastic paralysis in December, 1920, when in some cases of infantile hemiplegia he excised the first thoracic and inferior cervical ganglia with all their branches to the brachial plexus, without, however, producing any effect either on the circulation or the muscular tone of the limb. Now Hunter and Royle had at least demonstrated the feasibility of interrupting the sympathetic nerve supply of a limb by section of the rami communicantes, and he (Mr. Bankart) had done the operation of sympathetic ramisectomy ten times, cervical ramisectomy once, and lumbar ramisectomy nine times.

The operations in these cases were done exactly as described by Royle. In the cervical case the rami of the fifth cervical to first thoracic nerves inclusive were destroyed, while in the lumbar operations the grey rami of the second, third and fourth lumbar nerves and the sympathetic trunk below the last were divided. In order to anticipate any criticism with regard to the selection of cases or the technique of the operations, all the cases were seen by competent neurologists, and the operations were performed as "demonstration operations" in the presence of competent and critical witnesses ; and he could say that in these cases, at any rate, the correct rami, and in the lumbar operations the sympathetic trunk, had undoubtedly been divided.

The following cases were operated upon :—

(*A*) *Cervical Ramisectomy.*—Woman, aged 34. Sequelæ of encephalitis lethargica. Generalized muscular rigidity, upper limbs more than lower, right side more than left. Very much increased tone of upper limbs. Arms adducted, elbows and wrists flexed. Operation, March 20, 1925. Result : transient diminution of muscular tone and increased vascularity. End result : unchanged.

(*B*) *Lumbar Ramisectomy.*—(1) Girl, aged 13. Cerebral diplegia with marked spasticity and contractures of all four extremities. Operation first on right side and then on left, July, 1924. Result : vaso-dilatation and some diminution of hypertonus, and increased freedom of movement. No practical benefit.

(2) Man, aged 30. Myelitis with paraplegia in flexion and well-marked flexor spasms. Operation on left side, October 30, 1924. Result : vaso-dilatation and appreciable diminution

of muscular spasm, and freer movement of limb. Operation on right side, January 15, 1925. Result similar, but not so marked as after first operation. N.B.—Vaso-dilatation persisted for more than a year after operation. End result: no practical benefit.

(3) Man, aged 39. Spastic paralysis from cerebro-spinal syphilis. Hypertonus in all four limbs, in left more than right. Paraplegia in extension. Operation on left side, April 30, 1925. Result: no change in vascularity or muscular tonus.

(4) Woman, aged 30. Fracture of the cervical spine at age of 18. Paraplegia in extension with marked rigidity. Operation on left side, July 2, 1925. Result: no change in circulation or muscular tone.

(5) Woman, aged 52. Disseminated sclerosis. Marked spasticity of lower limbs, left more than right. Chief complaint stiffness of left lower limb. Operation on left side, February 20, 1925. Result: no change.

(6) Man, aged 27. Cerebral diplegia with great rigidity. Operation on right and left sides, July, 1925. Result: no change in circulation or muscular tone.

Summary.—Five of these operations were followed by general vaso-dilatation of the limb and by a diminution of muscular tone corresponding in degree to what might be expected from the accompanying vaso-dilatation. In at least one case the vaso-dilatation was noted to be still present more than a year after the operation. In no case had the diminution of muscular tone been sufficiently marked to be of real practical benefit to the patient. In the five remaining cases neither circulatory disturbance nor alteration in muscular tone was appreciable after operation.

Dr. F. M. R. Walshe, O.B.E.

said that Dr. Adrian had so completely and adequately covered the ground on the theoretical side of the problem before them that he would confine himself to dealing as briefly as possible with the criticisms which the opener had made of views which he had expressed elsewhere in a review of the subject under discussion. As he understood him, Professor Elliot Smith appeared to be under the impression that his description of one of Hunter's crucial experiments was not an accurate record of Hunter's published observations. The experiment in question consisted in division of the cervical posterior roots on one side in a fowl, care having been taken to preserve the "sympathetic afferent" supply to the wing, which entered the cord by the first thoracic posterior root. Examination of such a bird, which had been possible owing to the courtesy of the late Dr. Hunter, confirmed Hunter's statement that the affected wing, as it lay against the bird's supporting side, retained any degree of flexion and extension imposed upon it by the observer, the bird making no attempt to restore the wing actively to the initial position. However, with Hunter's conclusion that this indicated the presence of "lengthening" and "shortening" reactions and hence of a "plastic" component of tone he was wholly unable to agree, and for this reason. If the wing was horizontally abducted from the bird's side and then released, it dropped like a dead thing against the bird's side. In a word, it could not maintain a posture imposed upon it against the force of gravity, but only when supported. In consequence, it was clear that "plastic tone" as defined by Hunter was absent. In addition, the wing was wholly flaccid to passive movement and showed no trace of tonic activity of any kind.

Hence the existence of a separate "plastic" component of muscle tone received no confirmation from this experiment. But what went to the root of the matter was the fact that twenty years ago W. Trendelenburg had performed a carefully controlled series of similar experiments on pigeons, and had obtained profoundly different results. He had found that unilateral cervical and thoracic posterior root section on the pigeon—that is, both somatic and sympathetic de-afferentation—did not impair the bird's power to hold its wing in the normal posture, its power of voluntary movement or of flight. In one point his results agreed with Hunter's—namely, that the affected wing, when allowed to rest against the bird's side, could be passively

flexed and extended without the bird restoring it to the initial position. This he rightly correlated with the de-sensitization of the wing resulting from cervical posterior root section. His experiments showed that the afferent impulses determining the tone and posture of the wing did not arise in the wings at all, nor reach the cord by cervical or upper thoracic posterior roots. There was, therefore, no escape from the conclusion that the condition of the wing produced by Hunter's experimental procedures was not a clean picture of cervical root section, but was complicated by some associated lesion of the nervous system. What this might be it was impossible to determine in the absence of published anatomical control observations, but a concomitant ventral root damage provided a probable explanation.

Hunter's experiments on birds must therefore be regarded as not throwing any light upon the questions at issue.

Elsewhere, in the review now criticized by Professor Elliot Smith, he had given what he still regarded as adequate reasons for concluding that the parallel series of experiments on goats, designed and claimed to demonstrate the separate existence of a "contractile" component of muscle tone, had been equally unsuccessful.

In short, it was clear that his account of Hunter's experiments on fowls did not differ from the original descriptions, and that it was in the totally different matter of assessing and interpreting them that he had ventured to hold a contrary opinion to that expressed by Hunter.

Mr. Geoffrey Jefferson (Manchester).

I was in the United States of America when the first wave of enthusiasm for the new method of treatment of spastic paralysis began to spread. I had an opportunity of seeing two cases which were operated upon over there, and was rather disappointed, as were all concerned, with the result. I was disappointed because the reports which had come, some at first hand, from the Australian clinics had led everybody to expect a most dramatic change.

It is perhaps natural to deduce that technical errors in the operation, as performed by others, was the cause of the relative ill-success attending their efforts. It is possible that incomplete operations were indeed done in some of the early cases, but looking back on it all, one must now confess that greater proficiency has not, in my own hands at least, materially altered the results. In fact, the last case that I operated upon was more completely unchanged than any of the previous ones.

We can well understand and sympathize with the enthusiasm which greeted this new method of treatment, especially in so far as it was likely to affect spastic arms, for these have always been the bugbear of neurologist and surgeon alike. The spastic leg, of Little's disease for example, is not so serious a problem; very effective operative measures have long been in use for the lower limbs (neurotomies complete and partial, tendon lengthenings and the like). The arm is a different matter, and here I have found that we still had to face the old enemy—lack of sufficient higher control, both in quantity and in volume, rendering most operative measures futile. On this rock it seems to me that the operation of ramisectomy was likely to split in any case.

We had been led to believe, against our better judgment, that the chief disability in these cases was not so greatly loss of pyramidal control as the overmastering of this control by secondary muscle hypertonus; that if this tonus were removed a relatively useful motor function would reveal itself. Such, unfortunately, has not been my experience, and I have been able to detect so little functional improvement in my own operated cases that I doubt if I shall undertake the operation again. I concentrated my attention chiefly upon arms, but I have the impression that it is mainly in the case of operations on legs that the greatest success has been reported. There has certainly taken place in some of my cases a perceptible lessening of tone, perceptible not only to the patient, but also to the observer. But

in the arm the patient has never been able to make material use of it. It occurs to me that the more automatic and coarser movements of the leg might very possibly have been improved considerably by a diminution in tonus, small though it be.

I have operated on six cases, five cervical ramisectomies and one lumbar. All except one were performed on persons under the age of 20 years. The exception was a hemiplegic man aged 60 whose hand was converted from the typical congealed form with thumb adducted into the hand, to freely (passively) mobile digits and thumb. This was the first case and the results were encouraging, but unfortunately the man died of a second cerebral vascular lesion six weeks after the operation. Of the other four arm cases one was a traumatic hemiplegia, one had Little's disease, and one was a hemiplegia resulting either from a juvenile vascular lesion or a polio-encephalitis. All of these patients were, of course, ambulant, with the arm less recovered for practical uses than the leg. Each patient declared that since the operation the warmth of the arm was increased. On the whole the affected arm is still colder than the normal, but is not so chilled as formerly, and sometimes flushed considerably. The alteration in temperature was studied in one case following operation and showed a temperature on the sympathectomized side of from one to two degrees higher than its fellow for the first week. After this conditions became more normal, and in two weeks little or no difference was detectable. On the motor side, all patients, excepting one, state that there is a distinct gain of suppleness, a diminution in the subjective feeling of rigidity in the operated limb. One patient denies any change at all save the thermal improvement noted, which suggests that vascular dilatation may not be the only cause of relaxation experienced.

Objectively, it is exceedingly hard to devise tests which will demonstrate convincingly any lessening of tonus which may have been achieved, because the pyramidal control seems to be so deficient. Further, the spastic limb varies so much in the natural state, not only from day to day but from hour to hour, that honest conclusions are hard to draw. But it may be said that some loosening, some "limbering-up," followed in four of the arm cases, that in two cases a firmly closed hand was converted into one which was very easily (passively) spread and remained open in the rest position at times. In one the child's mother was aware of diminished tone by the greater ease with which she could dress the child, the arm no longer being held so rigidly against the body. I should add that these results were immediate and have in three cases persisted for over a year.

These facts are, in their very limited way, interesting, and conform closely to those obtained by other surgeons. But I cannot say that the operations have done any real good, and here I find myself in full agreement with Mr. Bankart. It may be that we have chosen the wrong cases, and I have had no experience with extra-pyramidal lesions which might, theoretically, constitute a richer field. It seems safe to say in conclusion that the hemiplegic arm remains the problem that it has always been, and that ramisectomy has done little or nothing in alleviation.

Dr. BEATTIE (replying on behalf of Professor Elliot Smith)

said, in answer to Dr. Walshe's remarks, that there was no question of injury of the anterior roots in the experiments which he himself had performed. The solution of the problem seemed to him to be in the direction of understanding the fatigue processes of the muscle. He mentioned that, in the opinion of Dr. Woollard, Garven's preparations proved nothing.

He had operated on a child, aged 7, who had never walked owing to a spastic paraplegia; clonus came on as soon as the lower limbs were put to the ground. A left-sided lumbar ramisectomy was performed in April, 1925, which was immediately followed by vaso-dilatation. Seven days later the child was able to put this foot to the ground and no clonus resulted. In June, 1925, the operation was done on the other side, and the child was now able to walk.

CASES SHOWN AT THE CLINICAL MEETING HELD AT THE NATIONAL HOSPITAL FOR THE PARALYSED AND EPILEPTIC, QUEEN SQUARE, W.C. 1, MARCH 11, 1926.

Chronic Progressive Polyneuritis with Unusual Distribution of Sensory Loss.

By C. P. SYMONDS, M.D.

D. H., AGED 22, states that she had diphtheria at the age of 6, and has ever since suffered from weakness of the lower limbs. This was not so severe as to prevent her from attending school, but she was unable to take part in any form of sport on account of the unsteadiness of her legs. On the whole she thinks the disability was slightly progressive. She did not notice any disability in the upper limbs until after she took up the occupation of waitress two years ago. Weakness and unsteadiness of the arms subsequently became so marked as to lead to constant breakages and the loss of her situation. During the past year or so she has suffered a good deal from cramps in the calves, and has had peculiar cutaneous sensations in both antecubital fossæ, which she describes as the skin "feeling sticky." On examination there is seen to be no defect of cerebral function, special senses or cranial nerves. There is generalized weakness, without any gross wasting, of all four limbs, with absence of tendon-jerks, except for the knee-jerks, which are both sluggish, and less easily obtained on the right. The abdominal reflexes are present, the plantar responses absent. There is relative anæsthesia to cotton wool and pin-prick from elbows to wrists, and knees to ankles, the hands and feet escaping. Sense of position poor in the toes, fair at larger joints. Vibration sense absent over the tibiæ. No loss of sphincter control. Gait, high stepping on a wide base. Wassermann reaction negative in blood and spinal fluid. Cells and protein, and colloidal benzoin curve normal in the latter. Test meal shows an acid-resisting juice and slight hyperchlorhydria. Urine contains no sugar. No evidence obtained of any chemical poisoning.

Lead Palsy with Spastic Paraplegia.

By C. P. SYMONDS, M.D.

C. S., AGED 53, first presented himself at hospital two years ago on account of weakness of the limbs. He had worked as a solderer for thirty years, being constantly exposed to the fumes of lead, but without ill effect, except for constipation and occasional colic. For several months previous to the present illness he had become over-conscientious at his work, and had spent his evenings and week-ends in the workroom.

Weakness was first noticed in the right hand two months before he was seen at hospital. He then experienced "cramps" and weakness in the right leg; the left limbs were subsequently affected in a similar fashion.

On examination he showed a typical blue line on the gums, and the blood showed a moderately severe anæmia with punctate basophilia.

In the nervous system no abnormality of special senses or cranial nerves was observed. The upper limbs presented the classical picture of lead palsy, atrophic paralysis of the long extensors of wrists and fingers, with some weakness and wasting of the shoulder girdles and intrinsic muscles of the hands. The supinator longus on both sides was spared. The lower limbs were weak, especially in movements of flexion, but not wasted. Both were slightly spastic in extension with increased tendon reflexes, and sustained ankle clonus. The plantar response on the

right was extensor, on the left indefinite. The abdominal reflexes were absent, except for an occasional twitch in the right lower quadrant. The supinator jerks were not obtained. There was no sensory loss nor any complaint of paræsthesiæ. Sphincter control was intact. The gait was spastic.

The Wassermann reaction was negative in blood and spinal fluid. The latter showed 0·07 per cent. protein and 12 lymphocytes per c.mm.

Under treatment this patient has made an almost complete recovery so far as the upper limbs are concerned. The lower limbs, however, are still somewhat weak and spastic, with increased tendon reflexes and ankle clonus, and the difficulty in walking remains a serious disability.

Myotonia Congenita.

By REDVERS N. IRONSIDE, M.B. (for F. M. R. WALSHE, O.B.E., M.D.).

J. G., AGED 22. No family history of nervous disease or disease similar to this obtained. Eighteen months ago patient noticed that at times his legs became stiff and rigid when he stood or walked and that the rigidity passed off in a few minutes. This still occurs several times a day. He has fallen during these spasms. Suffered from poisoned hand in April, 1925.

On Examination.—Discs, pupils and ocular movements normal. Generalized and marked enlargement of trunk- and limb-muscles. Herculean torso and limbs. Marked weakness of right arm and hand, slight in left arm. Marked myotonia of all limbs and trunk muscles. Myotonia of the tongue and in the facial muscles. Doubtful wasting of clavicular portion of sternomastoids. Tendon reflexes brisk, no delay in relaxation. Plantar responses flexor. No sphincter disturbance.

Spondylitis of Upper Cervical Vertebræ including Atlas and Axis, with Cord Compression. Typhoid Origin.

By REDVERS N. IRONSIDE, M.B. (for F. M. R. WALSHE, O.B.E., M.D.).

T. D., AGED 54. In 1890 patient had an illness called "enteric" at Malta. Had typhoid fever in 1908 and an illness diagnosed as typhoid in 1910 in Northern Ontario. Influenza with pneumonia and left empyema in 1920 (operation). Slight winter cough for six years. Seven years ago began to drop things from his left hand and noticed occasional jerkings of his head. Six years ago began to notice a hard lump on the back of his neck on the right side, and that his neck felt stiff. Had to wear a large collar. Three years ago weakness of the right upper limb. One year ago unsteadiness in walking, frequency of micturition, pins and needles in right elbow, voice becoming fainter. Occasional pain in inguinal region. No abscesses, no pyrexia.

On Examination.—Large reddish swelling in the cervical and suboccipital regions on the right side. Neck movements restricted. Much coarse crepitus and grating when head is moved. Pupils small, right slightly the larger; they do not dilate to shade but react to light. Nystagmoid movements to right and left. Jaw deviates to left. Weakness and wasting of extensors of elbows and supinators of wrist right and left. Grips good. Thoracic wall immobile. Abdominal wall spastic. Legs spastic in extension. Wasting of muscles of lower limbs.

To cutaneous warmth and pressure, pain: incomplete sensory loss over C. 1 to 5 on the right side, and C. 1 to 4 on the left. Hot and cold are not differentiated below

C. 2 level, but the responses are better on the left half of the trunk and limbs than over the right. Vibration sense absent over radial styloids and tibial malleolus. Sense of passive movement impaired in upper and lower limbs.

Reflexes: jaw-jerk absent. Tendon reflexes very brisk, except right triceps-jerk, which is feeble. Abdominals present. Plantar responses both extensor.

Frequency of micturition and difficulty in commencing micturition. Cerebro-spinal fluid clear. Protein 0·15 per cent. Nonne-Apelt reaction positive. Widal reaction positive 1 in 6 in cerebro-spinal fluid; positive 1 in 1,000 in blood.

Blood and cerebro-spinal fluid: Wassermann reaction negative. No other than coliform colonies grown from the stools.

X-ray examination shows gross bony deformity (kyphoscoliosis) of upper cervical vertebræ.

Two Cases of Disseminated Sclerosis with Vasomotor Changes.

By Redvers N. Ironside, M.B.

Case A. (*Patient of Dr. Collier.*)—A. C., female, aged 45. Onset of symptoms seven years ago (aged 38) with readily tiring, dragging and numbness of the left lower limb. Transient diplopia, which has since recurred at intervals. Frequency of micturition. Three years ago clumsiness and weakness of the left upper limb.

Previous History.—"Veins taken out" of right leg for varicose ulcer, four years ago. "Patch always"—cough, fever and loss of weight for several months in 1916. Four children—youngest has tuberculosis. Mother, aged 72, in hospital now because of weakness of arms and legs of several years' duration.

On Examination.—Left paracentral scotoma in nasal half of field. Optic discs pale, left more than right. Fine nystagmus on lateral deviation of eyes to left and right. Left lower facial asymmetry. Weakness of both upper limbs, left greater than right; left upper limb hypertonic "lead pipe variety." Action tremor left leg more than right. Both legs weak and spastic, left weaker than right. Sensory loss to cutaneous warmth and pressure pain over legs and trunk and arms to C. 4 level. Vibration absent on malleoli, present in arms. No loss of postural sense. Tendon reflexes very brisk, abdominal reflexes absent. Plantars: right extensor, left extensor. Frequency, urgency and difficulty in micturition. Slight right dorsal scoliosis. Cerebro-spinal fluid normal. Wassermann reaction negative in blood and cerebro-spinal fluid.

For the past two years patient has noticed at times a deep purple discoloration of the left foot and lower half of the left leg. Slight swelling. At times the foot is cherry red, at times almost black. It is quite painless.

Case B. (*Patient of Dr. Wilson.*)—G. S., female, aged 39. Three years ago she began to drag her left foot. Tires easily. During the past year urgency and frequency of micturition. No diplopia. Periods now regular, but ten years ago had amenorrhœa lasting ten months. During this time she used to lose consciousness for a few seconds at intervals of three to four months, following a flushing of the face.

On Examination.—Visual acuteness $\frac{6}{12}$ right and left. Right optic disc: marked temporal pallor. Left optic disc pale (medullated nerve fibres also). Nystagmoid jerkings of eyes on extreme right lateral deviation. Slight action tremor right and left. Legs very spastic, left more than right. Tendon reflexes brisk. Plantar responses extensor. Abdominal reflexes elicited, left tires easily. Vibration and postural sensibility impaired in lower limbs, normal in upper limbs. Cerebro-spinal fluid normal. Blood Wassermann reaction negative in blood and cerebro-spinal fluid. Hands succulent. Fingers either bright scarlet or bluish black. Subungual hæmorrhages in the third left finger. Nails transversely fissured. Frequent chilblains.

Quadriplegia. ? Progressive Muscular Atrophy.

By REDVERS N. IRONSIDE, M.B. (for T. GRAINGER STEWART, M.B.).

E. C., FEMALE, aged 41. Four years ago had "influenza" during pregnancy followed by cramps in thighs and difficulty in walking. No sore throat. Eighteen months later, left foot drop. Six months later right foot drop. Noticed quivering of muscles of thighs at this time. One year later became bedridden, noticed she could not lift her arms at the shoulders, although her hands were strong. Lately, weakness of back muscles; patient unable to sit up unless propped up.

Rheumatic fever when aged 9. Has never had diphtheria.

On Examination: Pupils react. Complete flaccid palsy of both lower limbs with only slight muscular wasting. No fibrillation. Weakness of trapezii and deltoids on both sides: of pronators of right wrist, of right triceps, and of left biceps and triceps; of supinators of left wrist and flexors of fingers. Left latissimus dorsi does not contract on coughing. Upward deviation of umbilicus of 1 in. Slight wasting of deltoids, supra- and infra-spinati, trapezii and erector spinæ glutei and vastus internus on the two sides. No fibrillation seen. No sensory defect. No tenderness of muscles. All tendon reflexes absent. Plantar reflexes absent at toes. No sphincter defect.

Muscles of lower limbs show complete reaction to degeneration; those of the upper limbs are either normal, or show partial reaction to degeneration.

Cerebro-spinal fluid normal. Wassermann reaction negative in blood and cerebro-spinal fluid.

Encephalitis Lethargica followed by Myelitis.

By C. M. HINDS HOWELL, M.D.

A. A., MALE, aged 40. Admitted January 30, 1926, with a two weeks' history of pain in the back, difficulty in walking of one week's duration and precipitant micturition for three days. Two days before admission he had cramp-like spasmodic pains in his right leg and occasionally in the left.

Family History.—Wife had three miscarriages. No living children.

Past History.—In November, 1925, patient became lethargic, fell asleep over his meals; his eyes continually blinked. He felt giddy and vomited on several occasions. By December his condition had improved.

In January, 1926, the pain in the back commenced in the upper dorsal spine and radiated into the right shoulder. Pain of girdle character was also complained of below the costal margin.

Cranial Nerves.—Nothing abnormal.

Some rigidity of neck. Unable to sit up on account of pain in back. Left arm weaker than right and showing slight generalized wasting. Reflexes: right brisker than left.

Both legs hypertonic, left more than right. Loss of power in both, more marked in left. Deep reflexes exaggerated. Right plantar response equivocal, left extensor. Clonus at both ankle-joints. Abdominal reflexes absent.

Sensation.—Impairment to cutaneous warmth; pressure pain in whole of right leg, thigh and trunk, and some impairment to pressure pain in right arm. There was a zone of hyperæsthesia extending round the body at level of D. 8 and 9. Other forms of sensation normal.

Retention of urine.

Three weeks later the sensory changes over thorax and abdomen could not be detected, but the impairment to pressure pain and cutaneous warmth remained in leg, thigh and arm. Power in legs and arm had become greater.

Cerebro-spinal fluid clear and colourless. Cells about 10 per cent. per c.mm. large mononuclears. Total protein 0·04 per cent. Nonne-Apelt reaction very weakly positive. Pandy: weakly +. Lange: no change in any tube. Wassermann reaction negative in blood and cerebro-spinal fluid.

Hereditary Ataxia.

By Arthur J. Davies, M.B. (for J. S. Risien Russell, M.D.).

R. J., male, aged 14. Four years' history of tremor in right hand when attempting to use it, coincident with a right-sided squint. Nine months ago, awkwardness of the right foot. Patient's symptoms have been steadily progressive; said to have been duller mentally of late.

Family History.—Six other children alive; eldest son said to "walk a little peculiarly." Eldest daughter has a congenital coloboma of iris. One other brother is said to have an awkward gait. Three still-births. Father and mother healthy.

Previous History.—Head was noticed to have been big at birth. Nine years ago had pneumonia; thinks "he has never been quite well since." Fundi normal; strabismus, right eye; nystagmus, on lateral ocular deviation. Other cranial nerves normal. Intention tremor and dysdiadockokinesis in right arm. Right leg hypertonic with slight general wasting; both feet in attitude of pes cavus, the right especially. No ataxia. No sensory disturbance. Knee- and ankle-jerks brisk, right more than left. Ill-sustained right ankle clonus. Both plantar responses flexor in type. Blood Wassermann reaction negative.

Myopathy with Fibrillation.

By Arthur J. Davies, M.B. (for J. S. Risien Russell, M.D.)

D. M., male, aged 30. Fifteen years' history of progressive weakness and wasting of muscles. At the age of six was noticed to tire very easily. Legs were affected first. About four years ago right arm was noticed to be wasted and weak, the left about two years ago.

Family History.—Sister suffering from similar condition. A sister died aged 4 years and never walked. Two others healthy. Father and mother healthy.

Cranial nerves: Nothing abnormal. Wasting of muscles of shoulder girdle, arms and forearms, more marked on right. Ribs prominent. Proximal muscles of legs wasted. Tibial and calf muscles show hypertrophy. Fibrillation has been seen in muscles of the shoulder girdle. All deep reflexes absent, both plantar responses flexor in type. Abdominals present. No sensory disturbance. Gait typically waddling. "Climbs up himself" when rising from the floor. Some precipitancy of micturition.

Myasthenia Gravis.

By Arthur J. Davies, M.B. (for J. S. Risien Russell, M.D.).

A. B., female, aged 50. Twelve months' history of drooping of eyelids, difficulty in speaking and in chewing foods; on one or two occasions regurgitation through nose. No diplopia. Condition varies, always worse towards night and better some days than others.

Family and Previous History.—Nil ad rem.

Speech nasal in character. Difficulty in pronouncing labials and dentals. Fundi normal. Ocular movements normal. Weakness of levatores palpebrarum, particularly left. Weakness of masseters and temporals. Lower jaw cannot be closed.

All facial muscles weak, particularly on left side: orbicularis oris especially affected. Palatal movement impaired, and uvula pulled over to right. Tongue lateral movements weak; no wasting. Head tends to fall about on shoulders. Slight scoliosis. Sits up in bed by rolling over on to left side and pushing herself up. No sensory disturbance. Arms and legs: nothing abnormal. Tendon reflexes brisk; abdominals absent; both plantar responses flexor in type.

Post-encephalitic Respiratory Disorder.

By MACDONALD CRITCHLEY, M.D. (for C. M. HINDS HOWELL, M.D.).

E. B., MALE, aged 31, had an attack of acute epidemic encephalitis in 1924, and states he has never felt well since. Six months ago he began to feel sensations of "rawness" behind his knees, associated with quickness of breathing.

Physical examination revealed a state of mild Parkinsonism. The respiratory disorder consists in paroxysms of noisy tachypnœa in which the respiration rate becomes as great as fifty per minute. He stands—during the attack—in a characteristic bowed attitude, swaying backwards and forwards with each respiration. After about thirty to fifty seconds he draws himself up and leans far back; the tachypnœa is now succeeded by a spell of full inspiratory apnœa lasting about fifteen to twenty seconds. The face and neck become suffused but there is no clouding or loss of consciousness. The apnœic phase is terminated by a prolonged expiration. These paroxysms come on at any time, but are more frequent towards nightfall. They tend to be more marked when under emotional stress. Vigorous external stimuli are often capable of arresting or diverting an attack. There is no inversion of the sleep rhythm and no conduct change, but there are possibly occasional hallucinations of hearing.

Cerebro-cerebellar Diplegia with Mirror Writing.

By MACDONALD CRITCHLEY, M.D. (for J. S. RISIEN RUSSELL, M.D.).

GIRL, aged 6. Was backward in sitting up and learning to walk. Her gait has always been very unsteady and there is some tremulousness of the arms. No mental impairment. Right handed.

Family history and previous health.—Nil ad rem.

Head somewhat enlarged; nystagmus on lateral deviation of the eyes. Slight intention tremor of both arms. Gait shows a cerebellar type of ataxy. All tendon jerks are brisk and there is a bilateral extensor plantar response. Writes "mirror fashion" with her left hand.

Progressive Muscular Atrophy due to Lead Poisoning.

By MACDONALD CRITCHLEY, M.D. (for S. A. KINNIER WILSON, M.D.)

MALE, aged 48, has been a coach painter for over ten years, using in his employment large quantities of lead paint. His present disability consists in weakness, cramps and fibrillation in the muscles of the legs. Symptoms commenced three years ago and are getting progressively worse.

There is definite weakness with atrophy of the muscles of the right leg; fibrillation is visible in muscles of upper and lower extremities. Abdominal reflexes present. Knee- and ankle-jerks obtainable; plantar responses are equivocal on the right side and extensor on the left. No sensory changes. Blood-pressure 100. Blue line on gums. Anæmia present, with polychromasia and basophil stippling of erythrocytes. No abdominal symptoms. No albuminuria.

Muscular Atrophy following Diphtheria.

By MACDONALD CRITCHLEY, M.D. (for S. A. KINNIER WILSON, M.D.)

J. P., MALE, aged 17, had an attack of diphtheria seven years ago, followed four months later by weakness in the right leg. The weakness progressed and extended to his other leg and later to his shoulder, muscles and trunk. The condition has been steadily progressive over the past seven years.

Family History.—Three sisters alive and well. Mother healthy ; father drowned.

Gross wasting and weakness of the muscles of the shoulder girdle, of the thighs and, to a lesser extent, of the trunk. No fibrillation visible. Tendon-jerks absent. No sensory loss. Scoliosis present. Definite " wasp-waist " deformity. Some winging of scapulæ ; patient tends to slip through one's hands when attempts are made to raise him by his armpits. Cranial nerves practically normal: some difficulty in whistling. No sphincter disturbance.

Section of Neurology.

President—Dr. H. Campbell Thomson.

The Pathology of the Parkinsonian Syndrome in Epidemic Encephalitis.

By Douglas McAlpine, M.D.

(From the Pathological Laboratory, Hospital for Epilepsy and Paralysis, Maida Vale, London.)

Epidemic encephalitis, since its appearance in this country in 1918, has left behind it an ever-increasing toll of victims. The most tragic and at the same time the most common sequel is undoubtedly the Parkinsonian syndrome.

I am afraid that what I have to say to-night will throw no light on the problem of treatment, but will, perhaps, indicate the reasons why, in an established case of Parkinsonism, little hope of cure can be entertained. However, the pathological study of Parkinsonism and other sequelæ, especially those characterized by involuntary movements, is tending to focus attention on certain regions of the brain little affected by other diseases of the central nervous system, and, by so doing, may help towards the solution of certain anatomical and physiological problems.

One cannot help being struck by the constancy of the clinical picture of the Parkinsonian syndrome and therefore one might expect that the localization of the lesion underlying this condition would be also constant. That this is so I will endeavour to show you.

I have been able to collect from the literature accounts of about seventy post-mortems on cases of Parkinsonism following epidemic encephalitis. It is, of course, impossible to go into all these in detail in the time at my disposal. I will merely give you the findings from one or two of the most important recent papers on the subject and then summarize the results of all the remaining cases.

Creutzfeldt [1] refers, in a recent paper, to two cases. The illness in the first of the two cases had lasted sixteen months. He found a marked outfall of the cells of the substantia nigra and the presence of acute inflammatory changes such as are met with in the initial stages of the disease. In the second case, in which the illness had lasted three years, the inflammatory changes were less marked. On the other hand, only a few of the pigmented cells of the substantia nigra remained. There was a marked increase of glial cells with fibre overgrowth in the region of the substantia nigra. In neither case was there any noteworthy change in the globus pallidus or putamen or caudate nucleus. Strauss and Globus [2] at the American Neurological Annual Meeting in May, 1923, reported the findings in a fatal case of Parkinsonism in a male aged 37, death occurring one year and eleven months after the acute attack. Macroscopically, they noted narrowing and pallor of the substantia nigra. Microscopically, the striatum appeared normal. There was no reduction in the cells of the globus pallidus and only slight degenerative changes in the motor cells. An occasional mild perivascular lymphocytosis in this region was present. The thalamus, red nucleus and corpus Luysii appeared normal. The substantia nigra showed definite changes consisting in a striking reduction in the number of pigmented cells, a marked gliosis and frequent perivascular infiltrations. McKinley and Gowan [3], in a paper which appeared in the January number of the *Archives of Neurology and Psychiatry* for the current year (1926), give details of the microscopical findings in two fatal cases of Parkinsonism.

The first case was that of a male, aged 27, who died six months after the acute attack. Except for scattered perivascular infiltration in the globus pallidus and putamen, no abnormality in the region of the basal ganglia was found. There was a marked loss of cells of the substantia nigra; many of the remaining cells showed degenerative changes. In this region there was pronounced perivascular infiltration and an increase in the number of glial cells.

The second case was that of a male, aged 20, who died three and a half years after the initial attack. Macroscopically, depigmentation of the substantia nigra was noted. Microscopically, the basal ganglia, pons, medulla and cerebellum were found normal, except for a very mild perivascular infiltration with here and there slight glial cell increase. The substantia nigra was profoundly altered, there being considerable cell loss. Many of the remaining cells were atrophied. Gliosis was marked.

These two observers used a micrometric method of counting the cells of the globus pallidus and substantia nigra, and therefore their findings are of considerable importance. In one other case previously reported by McKinley and in the two cases above mentioned, there was no reduction in the number of the cells of the globus pallidus, whilst the cells of the substantia nigra showed a diminution varying from 57 to 87 per cent. of the normal number. I shall have occasion later to comment on their method of counting.

Spatz [4] refers, in a recent paper, to fifteen cases of Parkinsonism, in which he has had an opportunity of examining the brains. He does not, however, give the details of the cases. He comments on the outfall and high grade atrophy of the cells of the substantia nigra. The basal ganglia, which in the acute stages share in the widespread inflammatory process, were affected little or not at all. He further adds that the protean nature of the symptoms in the acute phase of encephalitis is due to the widespread and varying histological changes, whilst the constancy of the clinical picture in Parkinsonism is due to the outfall of the cells of the substantia nigra, which, according to his experience, is a constant finding.

The most recent and extensive work on the pathology of post-encephalitic Parkinsonism has been carried out by L. Hohman [5] working under Professor Marburg in the Neurological Institute of the University of Vienna. His results appeared in the *Archives* of that Institute in May, 1925. Eleven cases of Parkinsonism were carefully examined histologically. In all the cases the most marked changes were found in the region of the substantia nigra. These changes consisted of a disappearance of a large proportion of the pigmented cells, destruction of many of the fibres and a slight increase in the number of glial cells. The putamen and caudate nucleus showed the next most serious lesion, which consisted of an outfall of the small polygonal cells, neuronophagia of a certain proportion of both small and large cells, increase in the glial element and lipoidal degeneration of many of the cells. The cells of the globus pallidus were involved to a less extent, as were also the cells of the cortex and dentate nucleus. Hohman agrees with the general findings of others to the effect that the substantia nigra is most involved in Parkinsonism, but owing to the widespread nature of the changes which he found in his cases, he is unable to make a definite statement as to the localization of the lesion responsible for the condition. Foix [6], Tarozzi [7], Vegni [8], Jacob [9], Lévy [10] and others have published accounts of one or more cases. In all these cases and in others which I commented upon in a paper in 1923, the substantia nigra showed definite changes, similar to those described in the foregoing. I have only been able to find an account of one case described as Parkinsonism in which the substantia nigra seemed normal.

This case, recently reported by Hassin and Bassoe [11], concerned a boy of thirteen who in February, 1920, fell and struck his head. Soon after he complained of headaches with nausea and a temperature of 100° F. was recorded. He was ill for sixteen months and was said to have had "sleepy sickness." He could not talk, and became stiff; later he developed convulsions. In September, 1922, he showed a marked arching forward of the body in walking. The speech was slow and drawling, and a coarse tremor was present in the arms.

Towards the end dysphagia became marked. There is no mention as to the presence or absence of involuntary laughing. Post mortem, the cortex appeared normal; the small cells of the corpus striatum and cells of the optic thalamus had undergone chromatolysis with neuroglial cell increase. The blood-vessels in these two parts showed perivascular infiltration. The cells of the globus pallidus were normal both in number and appearance; a few blood-vessels here showed infiltration with round cells. The cell structure of the substantia nigra was well developed and there was no glial proliferation in this region. The tegmental portion of the pons showed slight changes.

The authors consider the case to be probably one of post-encephalitic Parkinsonism, and they comment on the normal appearance of the substantia nigra. Granted that this be a case of Parkinsonism following encephalitis, there are certain features in the case which suggest that the Parkinsonism differed from the usual type. One sees occasionally, usually in persons under the age of twenty, a type of Parkinsonism in which there is marked flexion forward of the body, often coarse tremor, marked dysarthria and involuntary laughter. Rigidity is often more marked on one side, the leg on that side being flexed. The general appearance of such a patient bears a fairly close resemblance to that seen in progressive lenticular degeneration. It would seem highly probable that the situation of the lesion underlying this variety of Parkinsonism differs from that found in the usual form. The case reported by Hassin and Bassoe may belong to this group. It should be noted that both the globus pallidus and substantia nigra were reported to be normal. There is no mention in their account of the condition of the subthalamic nuclei.

The most important fact that emerges from a study of the published accounts of the morbid anatomy of Parkinsonism seems to be the constancy with which the maximum lesion has been found in the substantia nigra.

Anatomical and Experimental work in Connexion with the Substantia Nigra.

Within the last five years, anatomists and experimental workers have turned their attention to the substantia nigra, as a result of the striking predilection which the encephalitic virus shows towards this part of the mid-brain. Therefore I thought it might be of some interest to review shortly our present knowledge of the anatomy of this mass of grey matter.

I have derived a great deal of help in this direction from a study of the recent book by Foix and Nicolesco [6] on the anatomy of the basal ganglia, subthalamic region and mid-brain.

If a transverse section of the mid-brain at the level of the emergence of the third nerve be examined under a low power, one is struck by the large number of pigmented cells which go to form the substantia nigra on either side. Such an important collection of cells, far exceeding in number any other group in the brain stem and even outnumbering the cells of the globus pallidus, must fulfil some important function.

The substantia nigra is situated immediately dorsal to the pes pedunculi, containing the pyramidal fibres. In a vertical direction it extends from the subthalamic region to the junction between the mid-brain and pons. In a transverse section of the mid-brain the substantia nigra can be seen with the naked eye on each side as a broad dark band lying between the red nucleus and the pyramidal fibres. The colour is due to the black pigment which the cells of the substantia nigra contain. This pigment does not make its appearance until after the first few years of life and is not abundant until after the age of twenty. The cells of the substantia nigra in animals contain no pigment. The substantia nigra consists of two zones, the zona reticulata, which is placed ventrally and which contains relatively few nerve-cells but is rich in nerve processes; and the zona compacta, which lies more dorsally and which comprises the main body of the substantia nigra. The cells are large and

closely grouped together in islets. These islets form three main groups, external, middle and internal. The cells of the inner group are small as compared with those of the other two groups.

A typical cell of the substantia nigra is elongated, multipolar and has numerous dendrites. The pigment is generally grouped into a mass which lies towards one of the poles of the cell. It is from this pole that the axone arises. In a section stained by the method of Nissl, the chromatin substance is seen to be plentiful and is distributed throughout the cell except in the area occupied by pigment. The nucleus presents no point of special interest.

The substantia nigra is occupied by an extremely dense network of fibres. Towards its inner part and traversing it are seen the bulky fibres of the third nerve. With regard to the course of the fibres of the substantia nigra, these can be divided into two groups according to the direction they take. The first group contains fibres which can be traced outwards and upwards. At the level of the mesial fillet they bend sharply inwards so as to cross the fibres of the fillet at right angles. These fibres, although they do not form a compact bundle, are comparatively easy to follow up to this point, in Weigert-Pal sections, and constitute the so-called peduncle of the substantia nigra. Their ultimate destination is uncertain, but some, at least, join the fibres of the posterior commissure, so crossing to the opposite side. The second group comprises those that run ventrally into the midst of the pyramidal fibres and then appear to turn downwards. These fibres arise from cells of all parts of the substantia nigra but especially from the mesial group.

With regard to the development of the substantia nigra opinions are divided. Some anatomists believe that it arises as part of the mesencephalon, whilst others describe its origin from the diencephalon, from which the globus pallidus also develops. The upholders of this latter view are Mirto [12] and Spatz [4]. Mirto, in 1891, suggested a close relationship between the globus pallidus and substantia nigra and believed that they both originated from the diencephalon, but in the course of development became separated by the posterior limb of the internal capsule. Spatz, in 1922, supported Mirto's theory as to the close relationship between these two structures, basing his opinion on the equally intense iron-reaction shown by both these structures. Kappers [13] believes that the globus pallidus and substantia nigra have a common origin, namely, from the sulcus limitans.

A study of the comparative anatomy of the substantia nigra brings out several points of interest. According to Foix and Nicolesco, in the mouse and guinea-pig, the ventral zone, corresponding to the zona reticulata in man, contains many more cells than the zona compacta. The cells of the ventral zone are imbedded deep in the midst of the pyramidal fibres which form a relatively much smaller tract than in man. Corresponding to the peduncle of the substantia nigra in man, an efferent bundle of fibres runs dorsally outside the mesial fillet to reach the tegmentum. These fibres seem to be directed towards the posterior commissure and some cross the middle line with the fibres of the commissure. Others can be traced as far as the anterior quadrigeminal body and the grey substance surrounding the aqueduct of Sylvius.

In higher animals such as the dog a condition of affairs exists intermediate between that found in the guinea-pig and that in man. The pyramidal tract in the dog is even less bulky than in the guinea-pig. The ventral zone of cells is smaller, while the dorsal zone is larger, the reverse of what is seen in the guinea-pig. In the human fœtus the disposition of cells resembles, somewhat, that found in the dog, the zona reticulata being more in evidence than in adult man.

Foix and Nicolesco conclude that in animals the efferent path going dorsalward, corresponding to the peduncle of the substantia nigra in man, is the more important, whilst in man the fibres going into pes pedunculi and turning downwards are the more numerous.

A certain amount of experimental work in connexion with the substantia nigra has recently been carried out.

Dresel and Rothmann [14] removed the cortex and corpus striatum on one side in dogs; a few of these animals survived the operation for some months. The substantia nigra on the operated side showed marked cell outfall and glial proliferation. They also performed bilateral decerebration in other dogs and the substantia nigra was found to be markedly altered on both sides. In dogs in whom the cortex alone was interfered with no such changes in the substantia nigra were evident. These authors conclude, therefore, that changes in the substantia nigra occur as a result of interference with the corpus striatum and are not seen when the cortex alone is destroyed.

Ferraro [15], in a recent extensive experimental research on dogs and cats, comes to the following conclusions. First, extirpation of the cortex effects a reduction in the total volume of the substantia nigra, but the cells for the most part are conserved. Secondly, destruction of the corpus striatum, on the other hand, is followed by far-reaching degeneration of the cells of the substantia nigra. Some cell groups, however, seem unaffected and he concludes therefore that efferent fibres from the substantia nigra exist and that these may connect the substantia nigra with centres lower in the brain-stem. The experimental evidence afforded by these workers would suggest that any connexions that may exist between the cortex and the substantia nigra are unimportant, whereas fibres connecting the corpus striatum and substantia nigra do exist and they serve to link up closely these two parts of the extrapyramidal system.

Before leaving this part of the subject it remains for me to sum up the relationship between the substantia nigra and other parts of the brain, and in doing so I will follow closely the work of Foix and Nicolesco.

The efferent fibres of the substantia nigra can be divided into two main groups. First, those that penetrate into the midst of the pyramidal fibres and then turn downwards and therefore presumably serve to link up the substantia nigra with centres lower in the brain-stem. Secondly, those fibres that form the peduncle of the substantia nigra. Some of these fibres mingle with the fibres of the posterior commissure and probably serve as commissural fibres between each substantia nigra and also connect the substantia nigra of one side with other nuclei on the opposite side of the mid-brain. Foix and Nicolesco also suggest that there are other fibres in the peduncle of the substantia nigra which do not cross in the posterior commissure, but, instead, take a descending course and come into relationship with grey masses lower down. This supposition is supported by the work of Cajal, who found that certain fibres of the peduncle of the substantia nigra in animals bifurcated into ascending and descending branches.

There would, therefore, appear to be two descending tracts from the substantia nigra and one ascending, chiefly commissural. It is evident, however, that we are yet completely in the dark as to the exact termination of these efferent fibres.

With regard to the afferent fibres their existence is less wrapt in mystery. The work of C. and O. Vogt [16], Wilson [17], Dresel and Rothmann, Ferraro, &c., clearly shows the existence of important descending fibres to the substantia nigra from the corpus striatum, in particular from the globus pallidus.

As to whether the cortex sends fibres directly to the substantia nigra, as upheld by Dejerine [18] and others, it is more problematical. If such a connexion exists from the experimental work reviewed above, it would seem to play an unimportant part.

Personal Findings.

My own experience of the pathology of Parkinsonism following encephalitis is based upon the histological examination of nine cases carried out at the Hospital for Epilepsy and Paralysis, Maida Vale. The findings in one of these cases was

published in 1923 [19]. A detailed account of the findings in each case would prove tedious and I shall therefore only attempt to describe the salient feature of the pathological picture. Before doing so I will say a word about the methods used in this research. The following parts of the brain were examined in all nine cases. Frontal, parietal, Rolandic and occipital cortex. Basal ganglia, subthalamic region, mid-brain, pons, medulla and cerebellum. In eight out of the nine cases the lower half of the basal ganglia, the subthalamic region, mid-brain and upper pons were cut in series. I hoped to be able to trace secondary degenerations by means of the method of Weigert-Pal, and in five out of the nine cases the basal ganglia, mid-brain, pons and medulla were investigated by this method. At an earlier stage, however, frozen sections were taken from the mid-brain and subsequently frequent sections throughout the series were stained with hæmatoxylin and by van Gieson's method, and by the method of Mallory. In the remaining cases the basal ganglia on one side were treated by the method of Weigert-Pal and on the other side by the method of Nissl; the subthalamic region, mid-brain, &c., being used for Weigert-Pal sections.

Particular attention was paid to the corpus striatum and to certain masses of grey matter in the subthalamic region, the functions of which are unknown or uncertain, such as the substantia innominata of Reichert, corpus Luysii, &c.

In various papers dealing with this and allied subjects such terms as the following are often met with. "The motor cells of the globus pallidus appeared normal in number." "There was a marked outfall of the cells of the globus pallidus." Such expressions are somewhat vague, and in order to gain a rough idea of the number of cells in the globus pallidus in normal as well as in pathological cases, since 1923 I have used a simple method of counting, which is as follows. A horizontal section, cut at approximately 15 microns, passing through the basal ganglia at about the middle, shows the globus pallidus divided into two portions, an outer and an inner, which are separated one from the other by the external medullary lamina. Such a section, stained by the method of Nissl, is examined with a two-thirds objective, and a No. 4 eyepiece. The cells seen in six fields are counted, three fields being chosen from the outer segment of the globus pallidus and three from the inner. The fields should be so spaced that approximately the whole area of the globus pallidus is covered. In a number of normal controls I have found that the average count per field lies between forty and fifty cells.

This method has recently been adversely criticised by McKinley and Gowan [3], and certainly it cannot compare for accuracy with their micrometric method. The latter, however, is a long and tedious affair and seems to require a vast knowledge of mathematics. The method which I have described above is not accurate but for ordinary routine purpose it is sufficient.

Before giving you the results in the Parkinsonian cases, I should like for a moment to consider the changes that are met with in the acute stages of epidemic encephalitis, especially the question as to whether any one part of the brain is involved more than any other; and if this be so whether this throws any light on the problem of the localization of the lesion in Parkinsonism.

I had an opportunity of examining the brain of a young man aged 21 who died on the sixth day of an attack of acute encephalitis of the choreiform type.

> Macroscopically, there appeared to be intense congestion of the vessels in the basal ganglia and mid-brain, but especially in the latter. Microscopically, the cortex showed a generalized, discrete, perivascular lymphocytosis but was otherwise normal. There were no thromboses or hæmorrhages. The basal ganglia on the left side were normal except for moderate perivascular infiltration. On the right side the infiltration of the vessels was very marked in two situations, first, between the globus pallidus and putamen, and secondly, in the thalamus. There was, however, comparatively little infiltration of the surrounding parenchyma. The cells of the globus pallidus here and there showed

neuronophagia but the majority were normal. In sections through the subthalamic region the perivascular changes were more marked but they attained their maximum in the mid-brain. Here the vessels showed enormous cuffing, especially in the region of the substantia nigra and to a less extent in the grey matter below the aqueduct of Sylvius. In addition there was a general invasion of the parenchyma in these two situations with lymphocytes, &c., this again being more noticeable in the substantia nigra. It was remarkable to note the relative escape of the red nucleus, considering its close proximity to the substantia nigra. The upper part of the pons showed similar, though less well marked, changes, especially in the region of the locus cæruleus. The lower pons, medulla and cerebellum, beyond showing vessel infiltration, were normal. The inflammatory lesions in this case were widespread, but certainly varied in intensity, being more marked in the mid-brain, and especially in the substantia nigra, than elsewhere. The mid-brain from two other fatal cases of acute encephalitis showed intense inflammatory reaction in the mid-brain, both perivascular and parenchymatous. As in the above case, these changes were most marked in the substantia nigra.

Similar findings have been reported in the literature. From this somewhat scanty evidence one may deduce that in the majority of cases of acute encephalitis the inflammatory process, although widespread, affects chiefly the mid-brain and in particular the substantia nigra.

Turning now to the nine cases of Parkinsonism, the patients' ages ranged from twenty to fifty; all the cases were bilateral, and none of them showed marked tremor. The longest duration of the disease was eighteen months, and the shortest about six months.

The cortex appeared normal in all nine cases except two; in these a very occasional discrete perivascular lymphocytosis was noted.

The caudate nucleus and putamen were normal as regards the cells in eight out of the nine cases. In one case many of the large cells showed chromatolytic changes. These changes may have been, in part, due to the fact that this particular brain showed faulty fixation. Slight perivascular lymphocytosis was not uncommon, and the vessels in this region, as elsewhere, showed almost constantly a dilatation of their perivascular spaces. I shall comment on these changes later.

Apart from Hohman [5], other observers have not described any noteworthy lesion in the putamen and caudate nucleus. It is possible that Hohman was unacquainted with the normal appearance of the cells in this region. The large cells are rounder than those of the globus pallidus, and show a constant circle of satellite cells. Pigmentary degeneration, on which Hohman lays some stress, is usual in these cells in persons over the age of forty.

We now come to the globus pallidus. First, with regard to the cells, the counting method mentioned earlier was used. In all nine cases the average count lay between forty and fifty per field, which corresponds with the normal figures. Four out of the nine cases showed a count between forty and forty-two cells per field, and it is possible that in these cases there was a small reduction in the number of cells. For the most part the cells appeared healthy, but not uncommonly a few appeared shrunken or showed chromatolytic changes. I should add that this part of the brain is difficult to fix properly, and that a good Nissl preparation of the globus pallidus is not always easily obtained. The vessels in the globus pallidus showed the same changes as those in the putamen, namely, occasional discrete lymphocytosis and dilatation of the perivascular space.

In only three out of the nine cases were deposits of calcium-iron salts found in the vessel walls, or lying free in the parenchyma. In a paper written in 1923 [19], such deposits were described in several cases of acute encephalitis, and in one case of Parkinsonism, but an opinion was expressed that such changes were unimportant.

The infrequency of these deposits in the present series of cases would seem to support this view, as also does some recent work by F. W. Hurst [20], who examined the globus pallidus in one hundred brains, representing a wide range of diseases of the central nervous system, and found such deposits in the vessels in as many as 50 per cent. of the cases. Increase in the number of glial cells in the globus pallidus was only noted twice, and in each case this was very slight.

The thalamus, beyond vessel changes, was normal in all the cases. In the lower sections the perivascular lymphocytosis was more marked as a rule than higher up, especially in those vessels adjoining the ventricle. Some of these vessels at times contained blood in the spaces around them. I agree with Hohman that these hæmorrhages are probably terminal. Of the various nuclei in the subthalamic region three were especially examined; the substantia innominata of Reichert, situated in the region of the anterior perforated substance, the corpus Luysii and the upper part of the red nucleus. The first named was normal in all nine cases. The corpus Luysii appeared well developed, and the cells were normal throughout the series. In two cases there was a slight increase in the glial element. The same remarks may be applied to the upper part of the red nucleus.

In two out of the nine cases considerable overgrowth of neuroglial was noted in the region of the zona incerta. We now arrive at the mid-brain. In all nine cases definite changes were found in the substantia nigra. On cutting across the mid-brain from a case of Parkinsonism one can see with the naked eye that the zone normally occupied by the substantia nigra seems smaller, is poorly delimited, and is much paler as compared with the normal. This appearance is quite distinctive. The changes in the substantia nigra which were observed microscopically can be discussed under the following headings: (1) Nerve cells, (2) Neuroglial cells, (3) Blood-vessels, (4) Nerve fibres. With regard to the cell changes, the most constant feature was the marked outfall of cells. When compared with controls it was found that in some cases the cells had almost entirely disappeared. Here and there small groups of two or three cells remained, but these for the most part showed chromatolytic changes. In other cases, the reduction in the number of cells was less significant, scattered islets containing small groups of cells remaining, some of which contained normal cells. But in no case did the substantia nigra contain anything like the normal number of cells. Many of the cells that remained showed eccentricity of the nucleus, vacuolization, extrusion of the pigment, &c.

Clinically, all nine cases showed bilateral rigidity; pathologically, in every case the substantia nigra was affected on each side, though in one or two instances the reduction in the number of cells was more marked on one side. In seven out of the nine cases cell destruction was apparent throughout the substantia nigra; in two cases it was more marked in the inner portion of the zona compacta. As a result of the destruction of the cells quantities of pigment were observed lying free in the parenchyma; some of it could be traced to vessel walls, whence it had been carried by phagocytes. In persons under the age of twenty the scattered pigment will be scanty owing to the fact that the pigment in young persons is scarce. An increase of glial cells was present in all the cases in the region of the substantia nigra and was a marked feature, except in a solitary case. The commonest glial cell observed was one which had a fairly large oval pale nucleus containing chromatin dots and which showed scanty processes. Small and large astrocytes with abundant processes were also fairly common, as were neuroglial cells with rod-shaped nuclei. There was usually also an increase in the number of lymphocytes. In sections stained for neuroglia, a thick network of neuroglial fibres was present, which was more or less confined to the substantia nigra and the grey matter beneath the aqueduct of Sylvius. This network was especially marked in the vicinity of vessels. It was remarkable to note that the red nucleus remained more or less immune from these marked changes occurring in its neighbourhood. This gliosis of the substantia nigra is commented

upon by nearly all workers on the subject. With regard to the vessels, marked cuffing, such as is met with in the acute stages, was present in two or three cases in which death had taken place six months or so after the initial illness. In the case which had lasted eighteen months this perivascular lymphocytosis was less marked but was more evident in this region than elsewhere. Deposits of pigment in the adventitial spaces and thickening of the adventitia were the other noteworthy points. Earlier in this paper I mentioned dilatation of the perivascular spaces as being a common finding throughout the brain. I have not time to go into the various theories as to the causation of this condition, but will remark that it was fairly constant in the present series of cases and has been commented upon by many others. One other feature with regard to the vessels was noted, namely, an increase in the small capillaries in the region of the substantia nigra and in the grey matter underlying the aqueduct of Sylvius.

It was hoped that by means of Weigert-Pal sections degeneration in the fibre system of the substantia nigra would be detected and some light be thrown on the destination of the efferent fibres. This part of the work has proved very difficult and is far from being complete. In Weigert-Pal sections of the mid-brain, the thick network of fibres occupying the substantia nigra showed definite alterations. In some cases there appeared to be a thinning of this network; in others the fibres seemed numerous but many appeared to be interrupted in their course, the myelin sheath showing as a series of beads. Other fibres appeared broken across, the ends showing a large bulbous swelling.

The pons showed no alteration of note except in the grey matter below the aqueduct of Sylvius. Here, in the majority of cases, the vessels showed occasional mild cuffing and there was also a slight increase in the number of glial cells, especially in the region of the locus cæruleus, which, as will be remembered, is a small nucleus in this region, containing pigmented cells somewhat similar to those of the substantia nigra but differing from them in their rounded appearance. In two cases the cells of the locus cæruleus on one side only were almost entirely destroyed. Clinically, these two cases showed no signs that were more marked on one side as compared with the other.

The lower pons and medulla showed no alteration of note. The cerebellum and in particular the dentate nucleus appeared normal except for an occasional discrete perivascular lymphocytosis and slight increase in the number of glial cells.

To sum up, then, the changes in these series of cases, the maximum lesion in every case was found in the mid-brain and, in particular, in the substantia nigra, the cells of which in every case were markedly reduced in number, and degenerative changes were observed in the majority of those that remained. Other masses of grey matter in the extrapyramidal system, and in particular the globus pallidus, appeared for the most part normal. Such deviations from the normal that did occur were slight, and in the case of the globus pallidus would appear to be secondary. It is logical to assume that, as a consequence of the connexion between the corpus striatum and substantia nigra, retrograde changes may be found in the corpus striatum, as a result of a lesion of the substantia nigra.

In none of the nine cases was tremor a clinical feature. Hohman, in his series, had several cases showing well-marked tremor, but he was unable to demonstrate a lesion in any particular situation which might account for the tremor.

Two pathological conditions seem to be present in most cases of Parkinsonism. First, a subacute inflammatory process: this is suggested by the persistence of perivascular cuffing with lymphocytes and plasma cells, months or even years after the acute illness. Secondly, a process of sclerosis. This is especially evident in the substantia nigra. As the acute stage subsides, neuroglial cells proliferate. At first they act as scavengers, removing the débris of cells and pigment. As time goes on they lose their mobility, acquire processes and develop into typical astrocytes, so that a network of neuroglial fibres now pervades the affected area.

From my own finding and others, it seems fairly certain that the lesion underlying the Parkinsonian syndrome exists in the substantia nigra.

Before concluding, there are several points from the clinical aspect of the question which require explanation. First, can the latent period, amounting to months or years in some cases, between the acute attack and the appearance of Parkinsonism be explained on pathological grounds? Secondly, is the localization of the lesion in post-encephalitic Parkinsonism the same as in the idiopathic form of paralysis agitans?

With regard to the first question, I am afraid my material did not help me in this respect, as in none of the cases was there an interval exceeding a few months.

One might suppose, however, that in such cases the substantia nigra was little affected by the initial inflammatory process, but that this, remaining subacute, gradually resulted in a slow destruction of the cells of the substantia nigra with an accompanying sclerosis, or that the virus remained latent and subsequently the inflammatory process flared up.

The explanation of Parkinsonism occurring without any previous history of encephalitis might be explained in much the same way, i.e., by a mild encephalitis localized to the mid-brain. It would appear from such cases that the virus of epidemic encephalitis has a special predilection for the cells of the substantia nigra, just in the same way as the virus of poliomyelitis has for the anterior horn cells in the cord, and, further, that ambulatory forms of both do occur. Lastly, as to whether the situation of the lesion is the same in all forms of paralysis agitans, this is a question which is somewhat disputed. The majority of workers on idiopathic paralysis, including C. and O. Vogt [16], Lhermitte [22], Jacob [9] and others, believe that the essential lesion lies in the globus pallidus and to a less extent in the putamen. Trétiakoff [21], on the other hand, places the lesion, in the idiopathic form, in the substantia nigra. I had an opportunity two years ago, while in Paris, of studying some of the work representative of these two schools of thought. Trétiakoff based his views on the examination of eleven cases of paralysis agitans at the Salpêtrière, where I was able to see all his sections. In only two out of the eleven cases were the changes in the substantia nigra widespread. The ages in these two cases were 36 and 47; in both there was a history of encephalitis, and therefore it is safe to assume that the paralysis agitans was not of the idiopathic form. Of the remaining cases, seven showed localized disappearance of small groups of cells, but in none of these cases was there a lesion extensive enough, in my opinion, to account for a generalized paralysis agitans. In two cases the changes were so slight as to be practically negligible.

There were no sections of the basal ganglia, nor is any mention made of the globus pallidus in Trétiakoff's thesis. In view of this I, myself, attach no great importance to his findings, although his work is much quoted.

During the time which I spent in Professor Lhermitte's laboratory, I had an opportunity of going over his collection of sections, including eight cases of idiopathic paralysis agitans. Using the method of counting mentioned earlier, I found that the average reduction in the number of the cells of the globus pallidus was over 50 per cent. The case which showed the greatest reduction in cells was one of syphilitic paralysis agitans. The substantia nigra was also examined, and in four out of the eight cases it appeared normal; in the remaining three cases there was destruction of a small number of cells. Jacob, in fifty-three cases of idiopathic paralysis agitans, found alteration in the substantia nigra in only 14 per cent. That changes should sometimes be found in the substantia nigra in cases of idiopathic paralysis agitans, as a secondary phenomenon, is not to be wondered at if account be taken of the experimental work mentioned at the beginning of this paper.

I am much indebted to Professor A. J. Hall, who kindly placed at my disposal the material from six of the cases.

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SPECIMENS SHOWN AT PATHOLOGICAL MEETING HELD MAY 13, 1926.

Acute Disseminated Sclerosis.

Shown by DOUGLAS MCALPINE, M.D.

Case I.—FEMALE, aged 46. Total duration of illness, fourteen months.

Clinical Features.—Onset with right hemiplegia, fair recovery. Later, mental symptoms prominent and appearance of a marked tremor in right upper limb, suggesting red nucleus involvement.

Pathological Features.—(1) Numerous patches in subcortical white matter. Very few patches in cortex itself. (2) Numerous patches in relation to lateral ventricles. (3) Small patch occupying outer portion of left red nucleus.

Case II.—Female, aged 24. Total duration of illness, eleven months.

Clinical Features.—(1) Mainly spinal type, with termination of an acute myelitis. (2) Dental sepsis marked.

Pathological Features.—(1) Typical cord changes. (2) The patches in the brain were almost entirely confined to the lateral ventricles. (3) One or two patches in pons and cerebellum.

(1) Schilder's Encephalitis (Encephalitis Periaxialis Diffusa).

(Dr. GRAINGER STEWART'S Case) Shown by J. G. GREENFIELD, M.D.

D. W., FEMALE, aged 43.

Complaint.—Nausea, vomiting, ten to fourteen days. At work until June 9, 1925. On morning of June 10 could read quite well. Vision of right eye failed two days before that of left.

On June 12 (day of admission) could only distinguish form of objects. No hemianopia or diplopia. Cerebration still normal, but appears dull and stupid.

Visual Acuity.—Right eye, fingers at 1 metre. Left, 6/60. Right nasal field better than temporal. Left fields fairly full. Optic papillitis, right and left.

June 13.—Right eye $\frac{3}{4}$ hemianopia, sparing lower, outer field. Left eye $\frac{1}{4}$, almost horizontal hemianopia. Upper inner field almost gone.

Arms weak, especially left. Normal skin sensibility.

Arm-, knee- and ankle-jerks normal. Abdominal reflexes weak. Plantars, right flexor, left weak flexor.

June 17.—Complete paraplegia including arms.

(2) Suprapituitary Cystic Tumour (Adamantinoma).

(Dr. ADIE'S Case) Shown by J. G. GREENFIELD, M.D.

L. N., FEMALE, aged 27. Failing vision. Amenorrhœa. Increase in weight. Headache, vomiting. Falling out of hair. Drowsiness.

Amenorrhœa and failure of vision began at age of 17. For the last six months has gained in weight considerably. Hands fuller, but not wider. Headaches severe for six months.

On Examination.—Face doughy. Generally fat. Facial appearance infantile. No acromegaly. No axillary or pubic hair. Optic atrophy. Upper nasal quadrants of visual fields only left.

Operation performed.

Post-mortem.—Cystic tumour containing cholesterin crystals and fluids pressing backwards so as to destroy the posterior clinoid processes.

(3) Hemiplegia and Aphasia without Macroscopic Lesion.

(Dr. ADIE'S Case) Shown by J. G. GREENFIELD, M.D.

A. K., FEMALE, aged 63. Ten years ago began to drop things out of right hand. Four and a half years ago weakness right side, especially right arm. One year ago speech gradually became worse and she began also to have left-sided apraxia. For eighteen months constant twitching movements of fingers. Eyesight failing, especially noticeable on going downstairs, and she does not see so well on the right side.

On Examination.—Facial and brachial monoplegia. Intelligent but simple.

Aphasia.—Talks in disjointed manner. Difficulty in remembering words. Understands well and executes simple requests. Cannot write, copy, or write to dictation. Cannot name objects.

Complete *apraxia* of left arm.

Post-mortem.—Left side of brain smaller than right. Left hemisphere weighs 485 grm. Right hemisphere weighs 540 grm.

No macroscopic lesion of hemispheres on thin sections.

Case of ? Cerebral Glioma, ? Encephalitis, or ? Both Conditions Combined.

By C. WORSTER DROUGHT, M.D., and W. E. CARNEGIE DICKSON, M.D.

J. M. C., AGED 46. While on a visit to London from Ireland the patient's wife had a "stroke," with hemiplegia, and was admitted to hospital. Since hearing of this occurrence he was said to have become depressed and dazed, and at times was found to be searching for his wife behind various articles in his shop in Ireland. He then came to England, and the relative who met him thought that he had been drinking; he went to his usual hotel, but only sat in the hall all day in a confused condition. Later he became stuporose and was removed to hospital.

On admission: Semi-stuporose; took no notice of questions and mumbled only a few unintelligible words. His face was flushed and faintly cyanosed. The posterior cervical muscles showed slight rigidity, but Kernig's sign was absent. He was able to move his limbs freely and no paralysis could be detected. Pupils were slightly irregular and left greater than right. Reaction to light sluggish. Discs showed early secondary optic atrophy. Other cranial nerves normal. Arm-jerks were normal, knee- and ankle-jerks slightly increased; no ankle clonus, and plantar reflexes extensor. Double incontinence present. Temperature 98° F. Pulse 80 and blood-pressure 130/90. The blood yielded a negative Wassermann reaction. The cerebro-spinal fluid was faintly greenish-yellow in colour, with eleven small lymphocytes per c.mm., protein 0·08 per cent. and Wassermann reaction negative.

The physical signs remained substantially unaltered until death fifteen days later. Throughout the period of observation there was an irregular, intermittent pyrexia varying between normal in the morning to 101° F. at night. The pulse-rate varied between 110 and 80. His mental condition was usually that of stupor, with muttering delirium at times and occasional short lucid intervals.

Subsequent examinations of the cerebro-spinal fluid showed only a diminution in the number of lymphocytes; it was otherwise unchanged.

Pathological Examination.

Head.—Dura distinctly thickened and unduly adherent around the Pacchonian bodies; there was also some distinct old patchy pia-arachnoiditis over the hemispheres, most marked along the vertex. Considerable flattening of the convolutions, but general colour of brain pale, with only a moderate degree of congestion of the larger surface vessels.

Right optic nerve very distinctly smaller than left. The tuber cinereum bulged somewhat, from swelling both of itself and the subjacent tissue, there being no dilatation of the third ventricle. On slicing the brain there was well-marked softening (like over-boiled vegetable marrow) of the corpus striatum, on both sides, especially the globus pallidus. This softening was somewhat gelatinous, or like a soft-boiled vegetable, and the globus pallidus could almost be lifted out as a soft, plastic mass about the size of a walnut. It was semi-translucent and of a pale, pinkish flesh-colour. Nothing very much could be made out, naked-eye, in sections of the pons and medulla. Portions of all of these were put aside for microscopical examination.

Microscopically.

Sections of the central soft mass in the position of the globus pallidus consisted of closely aggregated small round cells, larger than lymphocytes, and with a very varying amount of intercellular tissue, at parts extremely scanty, the structure resembling that of a small round-celled sarcoma, invading and replacing the pre-existing tissues. Here and there the cells become slightly spindle-shaped, with rather more intercellular material. There are also at parts collections of small round cells about the size of lymphocytes, probably of the nature of "small-celled infiltration," and occasional polymorphs. These secondary inflammatory changes also extend outwards at the periphery of the more highly cellular mass; and there is, here and there, in the neighbouring brain-tissue, well marked "cuffing" along the lines of some of the capillaries and small arterioles, the whole suggesting a secondary encephalitis supervening in and around a small round-celled sarcoma (using this term to include the highly cellular or "atypical glioma," a "malignant epihyloma," according to Adami's classification).

Sections of a wide area throughout the region of the basal ganglia show an unusual form of "encephalitis"—*not* suggestive of encephalitis lethargica. I take these to be a widespread secondary encephalitis supervening around the tumour described above. The whole appearances are, however, rather unusual and difficult to interpret.

Numerous sections of the cerebral cortex, pons, medulla, &c., do not show any obvious abnormality—and nothing to suggest that the condition is one of encephalitis lethargica. The same holds good with regard to sections of the cerebellum.

The choroid plexuses of the lateral ventricles show an extreme degree of "brain-sand" formation.

Sections of the pituitary and liver do not show anything of note, beyond some congestion.

Summary.

Widespread "secondary encephalitis" of the basal ganglia and neighbouring parts of the base of the brain, supervening in and around a "small round-celled hyloma" or "sarcoma" (using the term as meaning a "pulp-tumour"), which may have originated as an atypical glioma, but which it is now difficult or impossible to differentiate from a "sarcoma" of mesoblastic origin.

Dr. Gordon Holmes, C.M.G., showed a Case of Pernicious Anæmia and Peripheral Neuritis. He discussed the differential diagnosis of subacute combined degeneration of the spinal cord and peripheral neuritis.

Dr. W. J. ADIE showed:—

(1) Two Cases of Erythrodermia Leukæmica, both cases of lymphatic leukæmia.

(2) Case of Osteitis Deformans. He discussed the blood changes in osteitis deformans.

(3) Case of Pernicious Anæmia. Patient, a female, came up to the out-patients at Charing Cross Hospital, with a red cell count of only 500,000 per c.mm.

(4) Dystrophia Myotonica.

The cases of Erythrodermia Leukæmica were discussed by the PRESIDENT and Dr. PARKES WEBER.

Dr. CHANDLER showed:—

(1) A girl with "Gigantism" and curtailment of fields of vision. The radiograph of the sella turcica appeared normal.

(2) Case of Pulmonary Tuberculosis being treated by means of artificial pneumothorax.

(3) Mediastinal Neoplasm. This case was discussed by Mr. J. E. H. ROBERTS, who said that it was impossible to tell the pathological nature of neoplasms of the thorax by X-rays. He suggested the advisability of surgical treatment of the case.

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DISCUSSION ON INFECTIVE ABORTION IN CATTLE AND ITS RELATION TO MALTA FEVER.

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The Society does not hold itself in any way responsible for the statements made or the views put forward in the various papers.

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President—Mr. T. G. Stevens, F.R.C.S.

Diagnostic Value and Therapeutic Application of Per-uterine Insufflation of the Fallopian Tubes in Cases of Sterility.

By I. C. Rubin, M.D., F.A.C.S. (New York).

I. Diagnostic Value of Per-uterine Tubal Insufflation.

Per-uterine tubal insufflation was devised for the specific purpose of determining the patency of the Fallopian tubes. In order to answer this question in cases of sterility one was obliged, before this method was available, to resort to exploratory laparotomy. For, in the majority of instances, normal tubes are not palpable *per vaginam* and diseased tubes are so often implicated with diseased ovaries that they are indistinguishable by vaginal touch. In many cases in which the tubal factor was not ascertained, operative procedures to relieve sterility could only fail in their object. Thus, all the otherwise technically excellent operations upon the cervix, not associated with an abdominal section, were futile in the presence of closed Fallopian tubes. Such an experience was all too commonly encountered, to the chagrin of the surgeon, and, what is more important, to the disappointment of the patient.

In 1914 I first attempted to arrive at a non-operative method for determining tubal patency by experiments on animals. Collargol was injected into the uterus and through the uterus into the tubes. Roentgenograms were then made and the shadowgraphs of the uterus and tubes were studied. It was soon seen that outlines of the tube lumen could be demonstrated. Cary appears to have been the first to try this method clinically. My own experience with per-uterine injection of collargol, and of thorium-bromide and iodide solutions, was not favourable. The peritoneal reactions in the patent tube cases were disagreeable. When collargol was employed, inspissation in the tube lumen persisted for some time,—an unhappy sequel in cases in which the tubes were open. In instances of non-patency, however, no harm could result to the patient.

In gas, used instead of opaque solutions, there was at once found the long-sought simple means of determining patency of the tubes. As the method developed it also proved of diagnostic aid in demonstrating non-patency. The method of per-uterine tubal insufflation, or tubal perflation through the uterus, was begun in November, 1919, at Mount Sinai Hospital, New York. The first clinical application was crude, but effective. Oxygen was allowed to pass into the peritoneal cavity of a patient who came to the clinic for the relief of sterility. The abdomen was observed closely until it was seen to rise; the patient complained of distension and epigastric pain, and, when she stood up, experienced severe pain in the shoulders and in the diaphragmatic region. The X-ray plates showed very definitely a general pneumoperitoneum. The quantity of the gas introduced into the peritoneal cavity of this first patient was estimated at about two litres.

This first experiment at once taught the necessity for: (1) reducing the amount of gas injected; (2) some manometric control; (3) some means of measuring the volume of gas to be insufflated. Accordingly there were adapted the siphon volumeter and a mercury or spring-type manometer. It was soon found that a

diminutive pneumoperitoneum under the diaphragm [1] (subphrenic pneumoperitoneum) was as easily demonstrable by fluoroscopy as the large-sized pneumoperitoneum by the X-ray plate. This was a definite improvement because of its clinical applicability in ambulatory cases. Another change was made by substituting carbon dioxide for oxygen. Carbon dioxide gas is very rapidly absorbed from the peritoneal cavity. When the amount used is 150 c.c. or less, phrenic irritation and shoulder pains are only momentary. By combining these factors, per-uterine tubal insufflation became an office procedure. The test requires one or two minutes to carry out completely and within from five to ten minutes the patient is ready to leave the office and able to go about her affairs.

The apparatus consists of: a tank containing 100 gallons of carbon dioxide under one thousand pounds, pressure; a reducing gauge; a siphon meter of the type employed in chlorinating water; a manometer (mercury or spring type); rubber tubing connecting the tank through volumeter and manometer to a metal cannula (Keyes-Ultzmann type), fenestrated at its tip; a rubber "acorn" (urethral tip) so fitted over the cannula as to allow the tip to enter well into the uterine cavity while the "acorn" itself engages the external os and thus prevents premature regurgitation of the gas along the cervical canal; a needle valve between the volumeter and the cannula. In most nulliparæ the "acorn" is not important; but in cases of relative sterility in which the external os is much dilated through cervical lacerations this rubber "urethral" tip is of great importance in order to make complete air-tightness possible.

Technique.

After the genital canal has been painted with tincture of iodine, as in preparing for a surgical procedure, a speculum exposes the cervix. The anterior lip of the cervix is grasped with a tenaculum. Gas is released from the tank and its displacement of the water in the siphon meter is noted; this must not exceed in rate three pulsations per minute. I have found that a time-ratio-flow of 15 seconds to raise the mercury column to 100 mm. is the most favourable rate of introduction of the gas into the uterus. It may be slower, i.e., it may require a longer time to raise the mercury column to 100 mm., e.g., 20-25 or 30 seconds, but it should never be less than 15 seconds.

The uniform rate-flow of 15 seconds to 100 mm. of mercury serves as a standard of comparison when several insufflations are necessary for the same patient. The data obtained are then more readily interpreted. We have thus learned, for example, to distinguish normally patent tubes from hopelessly closed tubes and from stenosed tubes that are amenable to treatment.

Having predetermined this uniform rate-flow of the gas, the cannula is inserted into the uterine cavity to a point just below the fundus, but well beyond the internal os. The pressure at the cannula tip at the time of introduction into the uterus is zero. This is accomplished by turning the needle valve until it is well open, and shutting it tight as soon as one is ready to allow the gas to pass through into the uterus. This moment is synchronous with the beginning of the pulsation in the volumeter, i.e., when the air is seen to approach the bottom of the U-tube in the siphon. That is easily controlled by the operator, and he counts the number of pulsations in order to calculate the total amount of gas he wishes to introduce.

For the average patient two pulsations are sufficient to establish a subphrenic pneumoperitoneum and its associated clinical manifestations. Each pulsation represents 30 to 40 c.c. of gas, as the case may be. The capacity of the glass siphon can be standardized for 30 c.c. or 40 c.c. In obese patients from three to five pulsations may be necessary. The quantity is seldom in excess of 200 c.c.

The manometer is observed in order to determine the point at which the pressure drops. This initial pressure-drop indicates the point at which the gas is released

through the tubes into the peritoneal cavity. In open tubes this is usually under 100 mm. Hg. When the tubes are closed the initial drop is not noted and the pressure rises steadily to 200. At this moment the valve at the tank should be shut and observation of the behaviour of the mercury manometer should be noted for a few seconds. The cannula and tenaculum are then withdrawn from the uterus. A scant drop or two of blood may be seen to escape from the external os, but this is of no significance. The slight ooze from the anterior lip of the cervix caused by the tenaculum is readily controlled by a cotton tampon which is to be left in for an hour or two. Careful notice is taken of the character and location of the pains produced by the injection of the gas through the uterus, for this point has definite diagnostic importance.

The patient rises from the examining table and is at once fluoroscoped. If the tubes are patent it will be possible to demonstrate with uniform regularity the presence of a single- or double-sided subphrenic pneumoperitoneum. If this be appreciable the patient will voluntarily state that she has pains in one or both shoulders. This latter symptom depends on the one hand upon the amount of gas introduced, and on the other hand upon the sensitiveness of the patient. Hypersensitive patients will notice the shoulder pains at once; phlegmatic patients may not notice them at all, or only upon being directly questioned regarding them. Sometimes the pains are experienced after the lapse of a few minutes. In general, less gas is required to evoke this symptom in thin than in obese individuals. When troublesome, the shoulder pains may be made to disappear instantly by the patient assuming the knee-chest posture. All patients feel well enough to dress and leave the office within a few minutes after the test.

(Dr. Rubin then described his apparatus and technique.)

Interpretation of Data.

(1) *Normal Tubes.*—The mercury rises to 40, 60, 80 or even 100 mm. and drops 10 to 40 points, fluctuating several times until the cannula is withdrawn. Usually the patient complains of slight pains referable to the uterus, which are sometimes described as similar to "unwell pains." Pain on the side is seldom experienced. The fluctuations in pressure are due to tubal peristalsis.

(2) *Closed Tubes.*—If one tube is closed or stenosed and the other normally open, the patient will complain of pain on the side of the tubal obstruction. If both tubes are stenosed or closed the pain is bilateral. This pain is due to distension of the tubes proximal to the point of obstruction, and it is present whenever the latter is situated at any point beyond the isthmus.

When the manometer rises to 200 mm. Hg, and uterine colic or mid-line pain referable to the suprasymphyseal area is complained of, but no complaint of pain on either side is made, the closure is located at the intramural portion of the tubes or very near the isthmus of each side.

I have found these observations to be practically pathognomonic of the site of obstruction; and I have not had to resort to the injection of opaque solutions into the uterus for this determination.

Spasm of the Tubes.

There are instances in which, after a relatively high pressure is reached, a drop will be noted, indicating that a small amount of gas escapes through a minute opening. As far as my observations have gone they point to the intramural portion and the fimbriated end of the tubes as the site of predilection for spasm. Studying this question with the aid of sodium bromide and sodium iodide injections into the uterus, Kennedy [2] maintains that he has been able to demonstrate isthmospasm. Meaker [3] appears to have indisputably demonstrated tubal spasm, by making X-ray pictures during injection of CO_2 gas and after half an hour's interval. During

the gas injection he was able to show a distended tube; this distension was not visible half an hour later.

Recently, I have attempted to study, by means of the kymograph, the behaviour of the uterus and tubes during insufflation. The results are interesting and promise to throw light on tubal physiology in the human species. So far, they tend to corroborate the findings of Dr. Snyder and Mr. Seckinger, of the Carnegie Institute in Washington, D.C. These authors studied the rhythmic contractions of the freshly removed uterus and tubes from patients at the Johns Hopkins Hospital. From the same laboratory, of which George L. Streeter is the director, Ferdinand C. Lee [4] reports some interesting observations bearing upon this question. He injected indian ink into the cornu of the uterus directed toward the Fallopian tube. The cat used in the experiment was not in the œstral period, the uterus being small and the ovaries showing no large follicles. He found

" that the ink would pass into the tubes but under great difficulty, a pressure of 280 mm. of mercury being frequently necessary in repeated experiments." " On the other hand, in the same animal, injections into the isthmus of the tube and directed towards the cornu passed easily into the uterus. However, when the uterus was large and swollen and when relatively large follicles appeared in the ovary, then the passage from the tube was easy. Experiments along the same lines on the dog and guinea-pig have so far indicated the same general phenomenon."

" The recent report of Rubin on the various pressures necessary for trans-uterine insufflation of the tubes at various stages in the intermenstrual period of the same individual is in harmony with the general principle obtained from work on the lower mammals. It is believed that the uterine end of the tube, through its varying degrees of patency, is to a great extent responsible for the differences in pressure he obtained. Furthermore, the material examined thus far indicates that the greater patency occurs about the period of ovulation, probably a little before that time."

Evidences of Tube Spasm.

The high pressure required to overcome an organic obstruction or stenosis may be distinguished from that due to a tube spasm, by application of the following technique: The cannula is to be held inside the uterus after the gas has been shut off. If a drop of the mercury is noted, and if this is not due to regurgitation from the cervical canal, it indicates a possible tubal spasm or the overcoming of an exceedingly narrow opening at some portion of the tube. Radiographic examination may demonstrate distension of the tube in instances in which the stenosis is near the fimbria or at the ampullary portion. Vaginal palpation immediately after the insufflation may demonstrate the distended tube; a few minutes later it becomes impalpable. Auscultation over the lower lateral abdominal areas—a step in the technique as first suggested by Henderson and Amos [5]—may distinguish the high-pitched note of stenosis from a lower-pitched note elicited on the normal side. The fluoroscopic examination or Roentgen film must show the presence of gas under the diaphragm. In favourable cases the distended tube may also be demonstrated, as Meaker [3] has shown. Differential point: if the gas on a second examination enters the peritoneal cavity freely, and at a lower pressure, it may be safe to assume that the Fallopian tube in that particular case was in spasm at the first insufflation. That this point must be of clinical importance, especially in instances of sterility, goes without saying. Further study with the kymograph may help to establish peculiarities in genital function that have hitherto escaped attention.

Simplified Methods.

It must be obvious that any method which does not offer the possibility of studying the question of tubal patency as outlined above must fail in eliciting important data. The most important factor is the uniform pressure-rate flow and volumetric control. All methods depending upon hand pressure, as when the syringe

or rubber bulb is employed, cannot possibly offer the even flow that can be obtained from a gas tank with an accurate release valve. There are a number of other disadvantages of simplified methods which, for lack of time, I shall not enter into. There is only one further point which it may not be amiss to emphasize in this connexion. Simplified methods of uterine insufflation have encouraged careless employment of the tubal patency test and may perhaps be responsible for disaster in some cases. This does not appear to have been adequately appreciated and I believe the factor of uniform pressure-rate flow to be of prime importance for the scientific and safe application of per-uterine tubal insufflation.

Contra-indications and Dangers.

The original method of per-uterine or "trans-uterine" tubal insufflation, as it was first termed by Peterson [5A], is apparently simple enough. It should be carried out in accordance with the rules that careful experiment and established experience have indicated. The patient must present none of the cardinal contra-indications. There must be no evidence of pelvic or genital suppuration, no pelvic tenderness, no inflammatory masses, no fever; nor must the patient be menstruating or bleeding from other causes at the time of insufflation. She must not be a patient who is suffering from serious cardiac, renal, pulmonary or great general metabolic disturbances. These latter conditions clearly forbid any but imperative diagnostic manipulations. As they arise in individuals who, in general, form poor subjects for pregnancy and labour, there would seem to be no need for, or value in, subjecting them to the test of tubal patency for diagnosis and therapy.

The dangers incidental to the method may be briefly summarized as due to: (1) misemployment of the procedure without due regard for the rigid rules of the technique; (2) an unfavourable time with regard to the menstrual cycle; (3) ill-chosen cases.

It may be said that where the test has been used most extensively and adequately—the cases aggregating thousands—no untoward results have been noted. Peterson and Cron, Ward, Aldridge, Meaker, Rongy, Hirst, Hunner, Bonney, and many others besides myself, have seen no bad effects. However, two fatalities have been reported to me as occurring in New York City, both of them inexcusable. A very careful inquiry into the circumstances of these deaths showed that the operator in each case violated the rules of technique, besides improperly selecting the case. In one case death was due to shock induced by a terrific injection of the gas in a woman aged forty-two, a quadripara suffering from cardio-renal disease. In the other case death was due to embolism, an excessive amount of gas under great pressure being introduced into the genitals of a patient suffering from multiple fibroids and bilateral pyosalpinx; forcible dilatation of an amputated cervix preceded and curettage followed the insufflation.

The danger from embolism in properly selected cases can be dismissed from consideration if the test is done correctly.

The only possible untoward effects may arise in those infrequent instances of chronic tubal suppuration in which the fimbriated end is still patent. As the pus, even in these cases, is usually innocuous, the danger from spilling into the peritoneal cavity will not be appreciable. Absence of tenderness on bimanual examination, and absence of reaction, may be taken as an assurance that the insufflation will not be followed by serious sequelæ. In doubtful cases the sedimentation test and observations on the behaviour of the temperature for twenty-four hours following the vaginal examination help to diagnose the presence of latent or subacute pelvic inflammation.

Choice of Time.

The most favourable time to carry out per-uterine tubal insufflation is from four to seven days after the cessation of a menstrual flow. During this time the endometrium is flat, the uterine ostia of the tubes are not obstructed by the swollen

endometrium obtaining in the pre-menstrual phase, and there is less apt to be bleeding. Moreover, it is the safest time, in that it will not interfere with a possibly impregnated ovum. Insemination soon after a post-menstrual insufflation will give the best chance for the spermatozoa to reach the tubes, where they may await and impregnate the ovum. Since adopting this rule I have noted a greater incidence of pregnancy.

Repetition of the Test.

Cases in which the tubes are demonstrated to be normally patent do not require a repetition of the test. If a subphrenic pneumoperitoneum is not produced the first time, however, it is well to repeat the insufflation after an interval of a month. Several trials may be made during the one examination, but it is preferable to defer the second trial. Three or four tests at the same relative date from successive regular menstrual periods have been carried out. A fifth or sixth trial can do no harm where the patient is anxious for a therapeutic result. Several of my patients, proved to have tubal patency on a fourth test and subsequently, gave birth to normal children. The second and third tests were done for corroboration of the original findings and for the purpose of formulating a more reliable prognosis. The indication for a plastic operation upon the tubes may at the same time be clearly established.

Effect on the Next Menstrual Period.

The next menstrual period is sometimes ushered in two or three days early. Peterson and Cron [6] have called attention to the relief of dysmenorrhœa in some cases and I have noted this in quite a number. Slight staining follows the insufflation for a day or two in a fair proportion of the cases, but it needs no special attention.

II. Therapeutic Application of Per-uterine Tubal Insufflation.

From the very outset the method was obviously seen to be one that might possess therapeutic as well as diagnostic value. Some authors appreciated this possibility and called attention to it. Peterson and Cron were the first to publish a paper on the therapeutic value of trans-uterine gas inflation [6]. I must say that although in this respect personal observations were accumulating, it was not until this past May (1925) that I was able to report at the meeting of the New York State Medical Association upon ninety-five cases of pregnancies out of a series of 1,000 consecutive insufflations. My chief interest until then was focused upon developing per-uterine tubal insufflation as a diagnostic procedure.

Peterson and Cron state that "a number of patients examined for sterility by the Rubin test where the gas had been forced through the tubes, reported that pregnancy had followed without change of other conditions present during the time they had been desirous of children. This led us to send follow-up letters to all women in whom gas had been successfully forced through the tubes, omitting, naturally, those cases where our investigations had shown that the husbands were the cause of sterility.". . . ." at varying periods following the Rubin test thirteen, or slightly more than one third of those women, became pregnant."

Thirty-six out of forty-seven women written to replied to their questionnaire.

"Thirty women had never been pregnant. Six women had conceived earlier in their married lives. Since four of the six women who were relatively sterile became pregnant after the passage of gas through the tubes, while nine of the thirty who were absolutely sterile conceived after gas inflation, it follows that something more than the mere passage of the gas and mechanical opening of the tubes must be considered in trying to explain the reason for the higher per cent. of pregnancies in those women who had previously conceived."

"Pregnancies in ten went to full term. Three resulted in spontaneous abortion at the third month. The younger the woman the greater will her chance of conceiving be. All but three became pregnant within six months after inflation (ten cases.) Five had only one

normal period. The shorter the period of sterility, the more quickly pregnancy supervened. None of the cases who conceived were operated on after the inflation and no treatment was instituted."

The analysis of the cases of pregnancy following per-uterine tubal insufflation made by these pioneers with this method has formed a basis for comparison with my own experience. In my series of 1,000 consecutive private patients seeking relief from sterility, ninety-five became pregnant following tubal perflation. These patients reported this fact voluntarily, no systematic questionnaire having been sent out. As no complete survey of this series has been made, the future may show the proportion of successful cases to be greater than 9·5 per cent.

There can be no doubt that introducing gas through the uterus and tubes into the peritoneal cavity does help certain women to conceive. The literature contains definite statements in this respect. Rongy was among the first to make special mention of pregnancy following the use of uterine insufflation and reported four pregnancies out of 152 cases examined by that method [7]. Besides Peterson and Cron's cases, S. R. Meaker [8] reports three cases of women married and sterile for two, four and ten years respectively, in whom pregnancy followed promptly upon the trans-uterine insufflation of gas. Two became pregnant immediately, and the third became pregnant two months after the test. In each case considerable difficulty was encountered in forcing gas through the tubes. This was accomplished in the first attempt in two cases and at the fourth attempt in the third case. Meaker urges that insufflation should be tried as a routine therapeutic measure in all cases in which every factor apart from the tubes has been excluded. In another publication Meaker has collected forty cases, including his own three, of pregnancy following trans-uterine insufflation. R. Cron [9] in discussing Henderson's and Amos's article, states that of fifty-eight patients to whom he had sent questionnaires, fourteen reported pregnancy. The majority became pregnant after one or two months, some after a second inflation. Incidentally, dysmenorrhœa was relieved in some cases also.

Heinrich Guthmann [10] reports that of fifteen patients in whom per-uterine insufflation was carried out three became pregnant soon after the test. He draws no conclusions.

P. H. Charbonnet [11] reports the case of a woman with a normal menstrual history, married six years without becoming pregnant. Pelvic examination was negative. The gas pressure rose to 200 mm. Hg; a second attempt resulted in the gas pressure rising to 180 mm. Hg, and suddenly dropping to 130 and 100 mm. Hg. One hundred and twenty c.c. of gas were used. She missed the following period and was four months pregnant at the time of his report.

Aldridge [12] reports 600 cases examined by per-uterine insufflation. Nine patients who were insufflated became pregnant. Other cases may have occurred but no systematic inquiry had been made.

One woman who had been married four years without conceiving required a maximum pressure of 250 mm. Hg at two trials. She became pregnant soon after the third test, which required 180 mm. Hg. Another woman aged 32, married eight years, had undergone a resection of the right tube and removal of a right parovarian cyst. On September 21, 1921, she was insufflated, the maximum pressure reaching 120 mm. Hg. On January 10, 1923, she was found to be four months pregnant.

A third case was that of a woman of 30, married eight years, with one child 7 years old, who became pregnant after the period following insufflation, the maximum pressure being 178 mm. Hg. Another woman of 26, married eight years, with one full-term 7-years old child, underwent a plastic operation upon her cervix uteri, resection of the left tube, and an operation for retroversion (Simpson), June 26, 1920. Uterine insufflation with maximum pressure of 190 mm. Hg was performed (date not given). On September 20, 1922, she was five and a half months pregnant.

A patient of 22, married six years, with one full-term 5-year-old child, underwent uterine insufflation December 7, 1922, the maximum pressure being 160 mm. Hg. On January 26, 1923, she was dilated and curetted. At her last examination in the follow-up (no date given) she was eight months pregnant.

Hirst and Mayer [13] report three cases in women

"who became pregnant so soon after the Rubin test that we are disinclined to view this phenomenon as incidental."

In their first case, a woman of 30, married eight years, who had had a dilatation and curettage for the relief of sterility four years before, on December 12, 1921, underwent a per-uterine insufflation and the pressure rose to 150 mm. Hg. Patency of the tubes was proved by the fluoroscope. On February 3, 1922, she was found pregnant.

A second case was that of a woman aged 26, married seven years and never pregnant. Dilatation and curettage one year after marriage. The pelvic examination was negative. By the insufflation test performed October 4, 1921, the Fallopian tubes were found to be patent. In January, 1922, she missed her menstrual period and proved to be pregnant.

The third case was that of a woman aged 27, married three years. Dilatation and curettage eighteen months after marriage, the uterus being then retroverted. Per-uterine insufflation, December 27, 1921, indicated non-patency. Before the test was to have been repeated she had missed her period and examination later revealed an undoubted pregnancy.

I have had several cases similar to this last-mentioned one of Hirst and Mayer and feel that in these particular instances uterine insufflation exerts a therapeutic influence.

Ottow (Dorpat) [14] believes that as a therapeutic measure the procedure is dangerous in the hands of the general practitioner, because of the possibility of its lighting up a gonorrhœal infection. With this view there can be little disagreement, except that the careful general practitioner who has acquired the technique of uterine insufflation may safely add this to his general diagnostic armamentarium.

The incidence of pregnancies following the use of per-uterine tubal insufflation is greater than the published reports would tend to show.

In November, 1923, I sent out questionnaires to individual operators and clinics using the "trans-uterine" insufflation apparatus made by E. Machlett and Son according to my design. Fifty-eight replies were received, thirty-five of which contained more or less complete data and twenty-three gave scanty data because the method had been but too recently used by the respondents. Of the thirty-five returned questionnaires containing data, twenty-four gave figures with respect to pregnancy following trans-uterine tubal insufflation. There were fifty-two pregnancies out of a total of 763 patients treated for sterility by the method of uterine insufflation.

These reports from the published and unpublished records are but a few of those which by now must have reached a substantial number. From these alone several conclusions may be drawn as to the therapeutic value of per-uterine tubal insufflation. The cases were properly chosen and serve to illustrate the type that may be benefited by the insufflation. The greater number of the women were married four or more years, and the sterility must in all probability have been due to some obstruction in the tubes, because of the initial high pressure. (Cases reported by Hirst, Mayer, Aldridge, Charbonnet, Meaker, and Mandelstamm.)

Particularly may the test be said to be of therapeutic value when a woman, sterile for a period of five years or more, becomes pregnant the month following a per-uterine insufflation. This therapeutic result may also be ascribed to the test even though two months elapse before pregnancy ensues. If other measures had been tried without avail the insufflation procedure may be presumed to have exercised a therapeutic effect. When the maximum pressure is not in excess of 100 mm. Hg and pregnancy soon follows it may be a mere coincidence. However,

as will be discussed later, the procedure may alter uterine conditions in such manner as to account for the relief of the sterility.

In the case of younger women and of those who have been married a short time the therapeutic value of the test is problematic. I am very reluctant to employ the test on women married less than one year. Yet there are women who for one reason or another urgently appeal for relief from an infertile mating of six months or more. These women, young or old, are not content to wait the traditional period of three or five years before considering themselves sterile. Modern society has so accustomed us to the delayed birth of the first child that we have almost come to accept it as the normal. Yet Matthews Duncan [15] has shown that on the average the first child is born about sixteen months after marriage. Giles [16], quoting Duncan, is led to the conclusion that when the first year has passed without any sign of pregnancy, an examination should be made to ascertain whether there is any cause. This question as to the time limit that should be set as marking a sterile marriage has engaged the attention of the profession and the laity for a long time.

A couple who have lived according to the normal marital habit, the wife a virgin at the time of marriage and the husband potent and free from venereal infection, may be justified in seeking an explanation for the failure of conception after six months. I shall not go into the conditions that render a woman absolutely sterile; such cases are rare indeed. Generally speaking, there are contributing factors, congenital or acquired, which most often are remediable. The examination may reveal no gross or apparent reason for the childlessness, though the couple be married six months or sixteen years. In either case they are potentially fertile. Instances of the first child being born from ten to twenty years after marriage are not infrequent and the incidence of first childbirths in the pre-menopause are also not unknown. These are encountered in women who have long ceased to undergo any treatment for their sterility; some may never have applied for medical relief. Therefore coincidence cannot always be dismissed. If per-uterine insufflation in otherwise unsuccessful and apparently hopeless cases facilitates fertility in an increasing number of women, it is fair to ascribe to it a therapeutic value equal to that of other well-established and well-recognized therapeutic agencies. Especially is this true in those cases in which a mechanical hindrance has been overcome by the insufflation.

Summary of Pregnancies following Per-uterine Insufflation.

In the 101 pregnancies occurring in my series, twenty-one women had been married between five and fifteen years. In eighteen cases the marriage was of between three and five years' duration, and sixty-one had been married between one and three years. Two were married less than one year. One was a nulliparous woman 40 years old, married three months; and the other a woman of 19 married six months. In each case there was a sufficiently important reason to make them seek advice concerning their infertility. If one applied rigid critique in the analysis of these cases, it would have to be admitted that the eighteen women who became pregnant after a period of nulliparity of five years or more were aided by per-uterine insufflation. Until more data accumulate, the five-year limit of nulliparity may serve as a criterion.

101 women became pregnant after per-uterine tubal insufflation.

	Cases
Primary sterility	62
Relative sterility	39
	101

Of the cases of relative sterility there were:—

One child sterility	11
,, and one miscarriage	4
,, and two spontaneous miscarriages	2
One stillbirth	2
Two children by a first marriage	1
One or more spontaneous miscarriages	12
One or more induced abortions	5
Ectopic gestation	2
	39

Married one year and under	14
,, between one and two years	32
,, ,, two and three years	15
,, ,, three and four years	7
,, ,, four and five years	11
,, ,, five and six years	5
,, ,, six and seven years	4
,, ,, seven and eight years	5
,, ,, eight and nine years	3
,, eleven years	2
,, fifteen years	2
,, but number of years unknown	1
	101

In 61 cases the marriage was between one and three years.
In two cases the marriage was under a year—in one case three months and the other one six months.
In 18 cases the marriage was between three and five years.
In 21 cases the marriage was between five and fifteen years.

How does Per-uterine Insufflation aid the Sterile Woman?

(1) By establishing patency of the genital tract from the external os to the abdominal opening of the Fallopian tubes. Any cervical canal that is patulous to the uterine cannula used in the uterine insufflation is ample for the entrance of spermatozoa. If the external os appears punctate or pin-point but admits the cannula, this is proof that it is wide enough to allow semen to enter the cervical canal. The cannula at the same time stretches it somewhat, rendering it more patent for a varying period of time. Should coitus take place shortly after this procedure the spermatozoa must have a better opportunity than otherwise of effecting an ascent in the uterine cavity.

(2) In some cases a mucous plug not visible at the external os, but occupying the deeper portion of the cervical canal, is seen to be expelled after the insufflation and on withdrawal of the uterine cannula. I have the impression that the removal of this mucous plug in this manner may be the important factor in some of the successful cases.

(3) By separating mild agglutinations of the folds of the tubal mucosa, by straightening out tortuous tubes, especially of the infantile type, by dislodging a mucous inspissation from a narrow to a wider portion of the tube, by actually separating adhesions at the fimbriated end in cases requiring 150 to 200 mm. Hg or more, a way is opened for the descending ovum to meet the ascending spermatozoa.

(4) Still another factor, not to be lost sight of, is the psychic impression which per-uterine insufflation makes on the patient. Although the exact nervous mechanism is not at present clear, there are women who respond to the physical stimulation of per-uterine insufflation through the psyche acting upon the autonomic genital apparatus. The question as to whether it induces a certain amount of relaxation in otherwise spastic tubes, the uterine openings of which are practically closed, must await further inquiry. That there actually exists, in certain tubes, spasm sufficient to close the uterine ostium in a manner similar to the closure of the internal os of the uterus, has been recently demonstrated. I have been able to convince myself of

the presence of spasm in a fair number of cases and believe that it is very common in the premenstrual or pregravid state and less common in the postmenstrual interval. Overcoming such spasm may be supposed to exert a therapeutic influence at least in some cases.

INDICATIONS FOR PER-UTERINE INSUFFLATION.

(1) Primary sterility, where contributing causes, including those for which the husband might be responsible, have been eliminated, and some operative procedure is contemplated. Here it has a definite prognostic as well as diagnostic value.

(2) Primary sterility in which the patient is known to have passed through a gonorrhœal pelvic infection soon after marriage and is at the time of the inquiry free from pelvic symptoms.

(3) Sterility following a pelvic exudate or abscess complicating a puerperium or abortion, with or without the history of an operation and where resolution has apparently taken place.

(4) Primary sterility in which the patient had peritonitis of appendicular origin in the premarital or postmarital state, to exclude tubal occlusion by peritoneal adhesions.

(5) One-child sterility without the definite history of pelvic infection.

(6) After one whole tube and part of another have been removed for hydrosalpinx or pyosaplinx (conservative surgery).

(7) After unilateral ectopic pregnancy, to determine the patency of the residual tube.

(8) After salpingostomy, to determine the success of the operation which was calculated to effect an opening of occluded tubes.

(9) After sterilization by tube ligation, to test the patency of the tied or severed tubes.

(10) After multiple myomectomy in nulliparæ, to make certain that at least the uterine ostium of the tube has been left intact.

(11) Sterility of long standing, where pelvic masses are palpable and clinically diagnosed as fibroids or "chronic disease of the adnexa." The test shows whether or not the tubes are open.

(12) As a therapeutic measure, to eliminate the tubal factor in sterility.

The causes of sterility are too often obscure. It appears that at least the mechanical factor of patency should be possible of determination in most cases. The method of inflating the uterus with carbon dioxide gas, with the production of an artificial pneumoperitoneum, obviates the necessity for surgical exploration and is especially serviceable in the obscure cases.

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Discussion.—Dr. T. W. EDEN said he had been interested in the question of tests for patency of the tubes, and had, in a number of cases, used the apparatus introduced into this country by Currier, of New York. He had employed it solely as a method of diagnosis, and he did not know that therapeutic effects were claimed for it, until listening to Dr. Rubin's paper. He thought that an extensive use of the apparatus, by a number of different observers, should be made before acceptance of the view that the passage of gas through the uterus and tubes could clear away non-organic obstructions which were the cause of sterility. At the same time, we know so little of the causes of sterility that a simple method of treatment, such as insufflation, would be heartily welcomed if experience should prove that it was efficacious. He agreed with the author of the paper in the view that a complete block could be registered by this instrument even when the tubes were patent. He had recently had two such cases, both having been operated upon immediately after the test was made. In one case the block was apparently due to kinking of the tube from retroversion, in the other the only morbid condition found was a small interstitial fibroid in the fundus, which might have so distorted the uterine cavity as to prevent the gas from entering the tubes, even under considerable pressure.

Mr. S. FORSDIKE said that inflation of the uterus and tubes had become a routine in the diagnostic investigation of sterility in the female, and the question at issue was, which was the best technique? Dr. Rubin, with some justification, considered that his apparatus was the best, condemning the syringe and bulb methods on account of possible fallacies due to a faulty bulb or leaking valve. These objections must be brushed aside, for it must be assumed that an investigator would only use apparatus which gave him constant and reliable results. He (Mr. Forsdike) had been using the bulb method for some time and had found it sufficiently reliable to justify him in continuing with it, considering its simplicity. In approximately 5 per cent. of cases air failed to pass through the tubes where it was found that they were patent on subsequent examination with lipiodol. One case was worthy of mention: that of a woman with a completely retroverted uterus; when the abdomen had been opened the uterus was found to be lying turned back in the pouch of Douglas. The uterine tube, with bulb attached, had been previously introduced. Inflation up to 200 mm. mercury filled the uterus, but no air passed through the tubes; on the uterus being lifted forward into the anteverted position air passed freely through one tube.

The greatest drawback to Dr. Rubin's method was that he relied upon the X-ray diagnosis of pneumoperitoneum. Under the application of his (Mr. Forsdike's) method, when the patient was in the Trendelenburg position, and the vagina filled with saline solution to indicate any escape of air, the pubic area formed the dome of the abdomen and the diagnosis was

established by auscultation over the abdominal ostia, where the air bubbles could be heard escaping, and by percussion over the suprapubic area where an increasing area of tympanites proved the presence of the pneumoperitoneum.

A further point he wished to make was that inflation alone was insufficient; it was necessary to carry the investigation further by means of opaque bodies, for if inflation was negative, nothing was known as to the site of obstruction, and this knowledge was essential to the ultimate decision as to whether an abdominal operation was justifiable. Most surgeons would agree that any operation upon the proximal end of the tube, with the object of restoring the lumen, was doomed to failure, whereas there was some prospect of success if the fimbriæ only required unfolding and the ovary placing in the lumen. The opaque body he had used was lipiodol, and this he used only after experimenting upon a series of cats in order to ascertain whether it had any ill-effect upon the peritoneum or the epithelium of the tubes. In no case was any adverse effect produced either macro- or microscopically, and this had been borne out in his subsequent work on the human female. Dr. Rubin disdained the investigation by opaque bodies on the ground that he was able to decide the seat of obstruction by the area in which the patient complained of pain, i.e., centrally or laterally. He (the speaker) hoped that Dr. Rubin would correct this impression by trying a series of cases with opaque bodies.

Mr. VICTOR BONNEY said that he desired to pay the highest tribute to Dr. Rubin's work, which constituted one of the greatest advances in gynæcology of recent years. He had already described the apparatus he had himself been using,[1] which had the advantage of being simpler than that devised by Dr. Rubin. That it was efficient he had proved on many occasions by opening the abdomen with the inflator *in situ*. One of the most important things that inflation had taught us was the futility of a large proportion of the salpingostomies performed before Dr. Rubin's discovery. He was perfectly certain in his own practice that in nine out of ten cases the tubes had remained blocked at the uterine end of the tube in spite of the new abdominal ostium. A new set of statistics would have to be prepared, dealing with the cases operated upon since inflation was practised as part of the operation. He was interested in hearing that Dr. Rubin had found what he himself had discovered, namely, that retroflexion in certain cases caused tubal occlusion by kinkage.

In regard to carrying out inflation in the consulting room he doubted very much whether it would ever come into vogue in this country. The majority of women here would not submit to any operative procedure without an anæsthetic; moreover, it increased the danger, as Dr. Rubin had pointed out, of the proceeding being carried out by relatively unskilled practitioners amidst unfavourable surroundings.

He had heard that very afternoon of a patient whose tubes he had inflated fourteen months ago, and, finding them closed, restored their patency by an abdominal operation, with the result that she was now four months pregnant. This lady owed her happiness to Dr. Rubin.

Mr. ALECK BOURNE said that he had been using the form of apparatus which was demonstrated to the Gynæcological Section of the British Medical Association, at Portsmouth, in 1923, by Dr. Gilman Currier, of New York, and that he had been very much pleased with the results obtained by its use. He (Mr. Bourne) would like to know if it was necessary to obtain proof of the entrance of gas into the peritoneal cavity by X-ray examination, or was it not sufficient to watch the gas pass into the uterus from the volumeter, and corroborate this evidence by stethoscopic indications heard over the hypogastrium? It seemed that in routine practice the use of X-rays was a serious disadvantage, and if proof of successful insufflation could be obtained by simpler means than radiography, the use of the apparatus would have a much wider scope.

[1] *Lancet*, November 22, 1924, p. 1062.

Lastly, he asked whether there was any difficulty in preventing back leakage around the rubber "acorn" in cases of laceration of the cervix. It appeared that the unevenness of the cervical circumference might easily give rise to defects in close co-action of the rubber "acorn" and external os.

Section of Obstetrics and Gynæcology.

President—Mr. T. G. Stevens, F.R.C.S.

Endometrioma Invading the Bladder removed from a Patient who had never Menstruated.

By H. Beckwith Whitehouse, M.S.

The specimen was removed from a single girl, aged 22, admitted to the General Hospital, Birmingham, on April 12, 1925, on account of severe and increasing abdominal pain, occurring at regular monthly intervals. She had never menstruated. The monthly pain had been present for four years, and for the three months previous to admission irritability of the bladder had become pronounced. The girl was occupied in a warehouse, but for some time she had had to give up her work owing to the severe character of the abdominal pain.

On examination, she appeared to be a well-developed individual with the secondary sex characteristics normally developed. *Per abdomen* nothing abnormal was detected, but on combined recto-abdominal examination the cervix uteri was found to be abnormally long, and a hard, tender, rounded swelling continuous with the uterine body could be palpated in front and somewhat to the left of the organ. The uterine appendages could not be felt apart from the general swelling, and the whole was fixed in the pelvis. The patient was a virgo intacta. A diagnosis was made of hæmorrhage in the rudimentary horn of a bi-cornute uterus.

On laparotomy, the relations of the pelvic viscera were found to be altered by the traction of dense inflammatory adhesions. Both ovaries and Fallopian tubes were closely bound down to the uterus by adhesions. On the antero-superior surface of the uterus a tumour, two and a half inches in diameter, was seen invading the peritoneum of the utero-vesical pouch and immovably attached to the bladder. The peritoneal adhesions were separated with some difficulty, but it was impossible to detach the tumour from the bladder-wall owing to the degree of infiltration present. A portion of the bladder-wall was therefore excised with the tumour, and a total hysterectomy with removal of both appendages performed. The patient made a normal afebrile convalescence and has since reported herself at the hospital in good health and free from any pelvic symptoms.

The specimen was dissected whilst fresh, and the uterine tumour proved to be a thick-walled cyst containing "tarry" blood attached to the anterior wall and fundus of the uterus, having no connexion with the uterine cavity but infiltrating the bladder-wall as far as the mucosa. Both ovaries and tubes were adherent but not infiltrated by the growth. The uterus itself was normal in length, with a small cavity and long adolescent type of cervix.

Sections of the endometrium showed a normal appearance of the stroma. The glands, although numerous, were small and showed no evidence of functional activity. The wall of the tumour presented the typical dilated glands of an endometrioma, embedded in dense fibrous tissue. A section through the whole wall of the uterus failed to show any connexion with the endometrium. The ovaries, although adherent, were not invaded by any epithelial elements from the endometrioma.

The specimen is brought before the Section as it appears to introduce a difficulty in the acceptance of the theory put forward by Sampson, Vernon Bailey, and others, that pelvic endometriomata are the result of endometrial grafts resulting from the back flow of the menstrual discharge from the uterus through the Fallopian tubes.

Endometrioma between the Layers of the Broad Ligament.

By H. Beckwith Whitehouse, M.S.

This specimen, consisting of the corpus uteri and right uterine appendages removed by subtotal hysterectomy from a married woman, aged 33, shows an endometrioma attached to the right lateral wall of the uterus, and occupying an intraligamentary position. It is in marked contrast to the preceding specimen in the total absence of adhesions. Also, there is no communication, either macroscopic or microscopic, with the uterine cavity. The tumour, about 1½ in. in diameter, is discrete, and consists of a thick-walled cyst containing "tarry" blood. The wall contains typical endometrial tissue, both stroma and glands being present and embedded in a matrix of fibrous tissue. The broad ligament has been incised over the tumour, but is not firmly attached to the latter, which occupies a purely intraligamentary site. The operation presented no great difficulty and the nature of the tumour was not recognized until it was incised in an attempt to perform myomectomy. Previously it had been considered to be a simple fibromyoma, and the operation was undertaken to relieve severe dysmenorrhœa, and the tendency to abort. The patient had been married for five and a half years, and during this period she had become pregnant on three occasions. Each pregnancy had terminated with an abortion at the end of the second month of gestation.

The position of the endometrioma between the layers of the broad ligament, and having no communication with the peritoneal cavity, appears to call for some other explanation than that based upon the assumption of endometrial grafts.

The specimens were discussed by the President (Mr. T. G. Stevens) and Dr. Nicholson.

Mr. H. Beckwith Whitehouse (in reply) referred to a tumour having the microscopical appearance of an adenomyoma, which had developed in the track of a drainage-tube following an operation for appendix abscess in a male. The tumour had been shown to him some years ago by his colleague, Mr. Frank Barnes, at the General Hospital, Birmingham, who had removed it. He (the speaker) personally found much difficulty in accepting the veracity of the recent theories which had been put forward to account for the origin of these interesting tumours, and this difficulty had been increased since the two specimens which he had been showing this evening had come under his notice. Metaplasia of the peritoneal epithelium appeared to offer a sounder and more reasonable explanation, especially when taken into consideration with the embryological data.

Malignant Endometrioma with Metastases in the Lungs.[1]

By A. P. Thomson, M.D.

Dr. A. P. Thomson (Birmingham) described the case of a young woman who had died after developing intense varying cyanosis and erythræmia associated with chylous pleural and peritoneal effusions, for which no satisfactory explanation had been found during life.

Post mortem.—A tumour of the recto-genital pouch was found, together with some enlarged glands along the abdominal aorta which appeared to have given rise to the chylous effusions by direct pressure on the thoracic duct. The lungs showed a curious coarse emphysema and were extremely friable: all the other organs were normal.

Dr. F. W. Mason Lamb showed sections of the tumour, of the aortic glands and of the lungs. The tumour was an adenomyoma, of which the muscle elements had become malignant and had formed metastases in the glands and the lungs. In the

[1] Abstract of paper to be published in full in *Quarterly Journal of Medicine.*

lungs the metastasis took the form of diffuse infiltration of the alveolar walls with smooth muscle fibres, which had acted as a barrier to the oxygenation of the blood without impeding its flow.

[*November 5*, 1925.

Specimen of a Fibromyoma of the Uterus, weighing 47 lb. 5 oz., Successfully Removed from a Patient aged 59.[1]

Shown by T. G. STEVENS, F.R.C.S. (President).

THE tumour had been known to exist for twenty years, but the patient would not agree to its removal so long as she could manage to get about. Latterly, she had not been able to walk without assistance and consequently expressed a wish to have it removed. It was recognized that the difficulty to be encountered in removing so large a tumour lay in its great weight. He (Mr. Stevens) therefore rigged up a block and tackle apparatus, with four large hooks attached, for the purpose of holding up the tumour during the operation and of enabling the broad ligaments and cervix to be brought into easy reach. This apparatus answered the purpose perfectly, with the result that the operation was concluded in thirty-five minutes. The patient made a good recovery, and three months afterwards was learning to walk, as she had lost the power of balancing herself under normal conditions.

Specimen of a Large Cystic Tumour of the Liver Simulating an Ovarian Cyst.[1]

Shown by T. G. STEVENS, F.R.C.S. (President).

THE tumour was removed from a patient aged 52, whose only complaint was enlargement of the abdomen. The menopause had occurred two years previously, without any important symptoms.

The tumour was about the size of a twenty-eight weeks' pregnancy; it had the consistence of a multilocular ovarian cyst resting on the pelvic brim and appeared to be made up of two parts. The upper and smaller part was under the left ribs, and before operation was not obviously connected with the main tumour. At the operation the only connexions of the tumour were with the liver and the anterior surface of the omentum. Many adhesions to the omentum were ligatured and the attachment to the liver was severed after mattress sutures had been put through the hepatic tissues. Microscopically, the tumour was a spindle-celled sarcoma. Whether it had really grown from the hepatic capsule or had acquired a secondary attachment to it could not be decided. The tumour did not actually invade the liver.

Discussion.—Mr. W. MCK. H. MCCULLAGH said that a specimen had been shown by him at the Section in January last, with the kind permission of Dr. C. H. Roberts, from whose case the specimen was taken. The tumour had a similar appearance and connexions at the exploratory laparotomy, and was found afterwards to be a columnar-celled carcinoma arising from the gall-bladder. The patient was 57 years of age and had been sent to hospital as a case of twisted or malignant ovarian cyst.

Dr. R. DONALDSON said that he was specially interested in the tumour shown by the President as, only a few days ago, he (Dr. Donaldson) had received for examination a tumour of similar appearance. This tumour, about the size of two fists, had been removed at operation by Mr. Ivor Back, who found it attached by a thin, short pedicle to the greater curvature of the stomach. There were no adhesions. He (Dr. Donaldson) suggested that the tumour shown by the President might be that rare form of tumour—a myosarcoma—which had originated in the stomach and had become detached from it after becoming adherent to omentum and liver, in this way receiving a sufficient blood-supply for its continued growth.

[1] To be reported in full in the *Journal of Obstetrics and Gynæcology of the British Empire*.

A Case of Early Endometrioma of the Fallopian Tube.

By Donald W. Roy, M.B., F.R.C.S., and Robert Donaldson, M.D.

Mrs. A. B., aged 46 years, was seen by one of us (D. W. R.) at St. George's Hospital on November 29, 1924. She had been married for twenty-two years and had had no children. She had had a miscarriage at the second month, fifteen years previously.

She was complaining of backache, pains in the left lower abdomen, menorrhagia (rhythm $\frac{10-13}{21}$) and leucorrhœa of two years' duration. She had noticed pain throughout the periods for four years.

On bimanual examination, a mass of uterine fibroids, reaching just above the pelvic brim, and more or less filling up the pelvic cavity, could be felt.

At the operation on December 10, 1924, seventeen days after the last period, multiple uterine fibroids were found and at first an ordinary conservative, subtotal hysterectomy was performed.

On closer examination of the right Fallopian tube an unusual condition was noticed. The greater part of the tube appeared to be normal, there were no adhesions and the abdominal ostium was open, but the fimbrial extremity and the region round the ostium were scattered over with small raised dark-red granules of various sizes. These extended also on to the peritoneum in the immediate neighbourhood of the fimbriæ and especially on to the infundibulo-pelvic ligament, where they were aggregated into a small mass the size of a cherry stone. The right ovary, which lay immediately below, and in front of this, was free from this abnormal condition. The left tube and ovary and the rest of the pelvic peritoneum were also quite free and apparently normal. The only other abnormality was the fibromyomatous uterus which had just been removed.

The whole area affected measured about half an inch in diameter. The naked-eye appearance and distribution of these red granules suggested that there here was an atypical form of granulation tissue, which had resulted from some spread of infection from the tube to the immediate neighbourhood of the abdominal ostium.

The tube was therefore removed. But as the tissue was highly vascular and the portion on the ovario-pelvic ligament bled readily to the touch, so that its removal seemed likely to entail the ligature of the ovarian vessels and perhaps the removal of the right ovary, that part of the tissue was left *in situ*—the supposition being that it was granulation tissue which would disappear when the focus of infection believed to exist in the tube was removed.

Fig. 1 represents a picture drawn from a description of the naked eye appearance seen at the operation.

Microscopical examination of the uterus showed it to be the seat of ordinary fibromyomata, and it was unfortunately not preserved. The tube, however, was kept and sections were cut, first of the fimbriated extremity, and, later, through other parts of its length by one of us (R. D.)

The sections of the fimbriated extremity showed that what had been taken to be granulations consisted of tissue, showing definitely the structure of endometrium with well-formed uterine glands of various sizes, and typical stroma with much extravasated blood and numerous blood-vessels. This endometrium-like tissue was distributed in irregular masses and not in a continuous layer, being in some places apparently plastered on to the fimbriæ. It was practically everywhere clearly marked off from the underlying fibrous and muscular tissue of the tube and showed little sign of invading it to any depth. The lumen of the tube was quite empty and contained no obvious endometrial tissue, but the walls of the tube showed slight inflammatory reaction and an excess of polymorphonuclear cells. The general

FIG. 1.—Drawn from a description of the condition seen at the operation (D. W. R.) Shows tissue resembling granulations on fimbriæ and infundibulo-pelvic ligament.

FIG. 2.—Showing distribution of endometrial tissue darkly shaded under very low power.

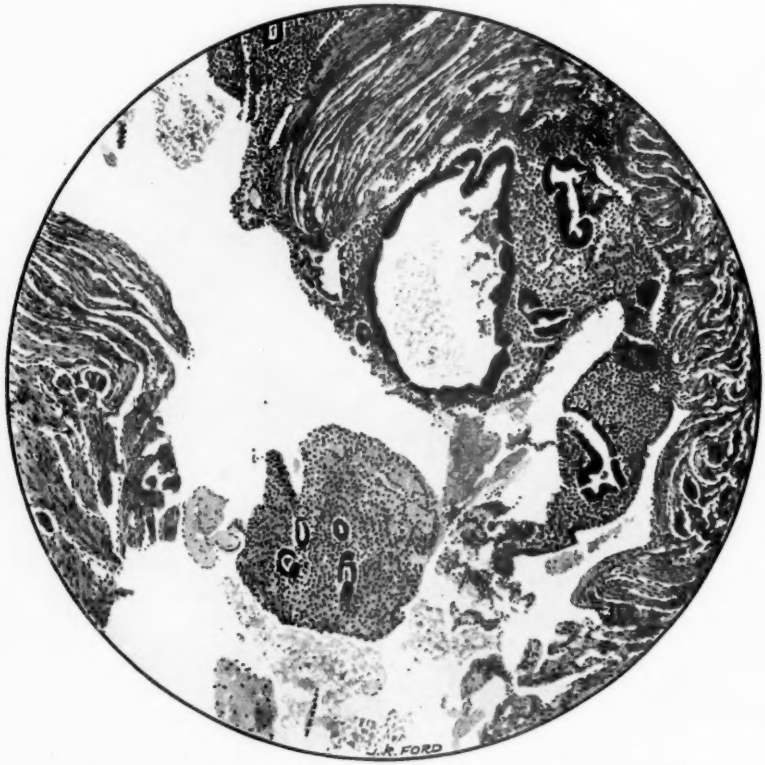

FIG. 3.—Showing endometrial tissue glands and stroma with blood extravasation lying in contact with tube-wall.

distribution of the endometrial tissue in relation to the fimbriæ and tube in section is shown by the tracing made from a section (fig. 2).

In fig. 3, a typical area of endometrial tissue, one of many present in the slide, is seen under a low power.

Further sections of the Fallopian tube were made to discover whether any portions of endometrium could be found in its lumen or in the tubal mucosa. In neither position was any found.

Conclusions.

Perhaps it may be thought that an apology is now needed for showing still another case of endometrioma. Our justification for so doing lies in the fact of the great importance of any case which may throw further light on the question of the origin of endometrial implantation in the pelvis. The theory of Sampson as to the origin of endometrioma of the ovary from portions of endometrium that have passed up the tubes is gaining ground, but its validity must remain *sub judice*, until cases are forthcoming in which endometrium is found either in the tube on its way to be implanted, or in such a position and so distributed that everything points to its having recently made its exit from the internal ostium of the tube.

It seems to us, that in this case, judging from the situation, distribution and arrangement of the endometrial tissue, there is strong evidence that we have here an implantation of endometrium, even though there is lacking such complete proof as would be furnished by the presence of endometrium actually within the lumen of the tube.

Any suggestion that relics of Müllerian origin surviving in the position could give rise to such a distribution of endometrial tissue seems a most improbable one. It seems equally improbable that the fimbriæ and peritoneum in their neighbourhood could react to some unknown stimulus, so as to form a tissue resembling endometrium arranged in patches and nodules of varying size between and overlying normal fimbriæ. No sign of a similar condition, of which the endometrial tissue on the tube could have been part, was seen anywhere else in the pelvis.

The presumption that this endometrial tissue came from within the tube, and proceeded thence from the uterus, is therefore very strong. Neither is this presumption weakened because, before there was any suspicion that the abnormal tissue was of the nature of endometrium, its origin was believed to be something infective that, as was supposed, had passed up the tube.

The condition, in our opinion, can only be reasonably explained by the thesis that it is an implantation of endometrium on and about the fimbriæ of the tube, its origin in all probability being from the uterine endometrium via the tube.

If these observations have been correctly interpreted, it seems worth while to put the case on record as a piece of fresh evidence in support of Sampson's theory of the origin of endometrial implantations on the ovary and pelvic peritoneum.

Another point of interest that arises out of this case is the probable fate of the portion of endometrial tissue left on the infundibulo-pelvic ligament. If its origin is other than we have suggested, there is no reason why it should not go on growing, as the removal of uterus and tube should have no bearing on its persistence. If on the other hand it is a piece of detached endometrium, by analogy with other cases of implantation of benign new growth on the peritoneum, one would expect it to be short-lived, when once the parent tissue in the uterus had been removed.

According to Sampson endometrial implantations find their most favourable environment in the ovary, though even there, according to Bailey, the implantations eventually degenerate, losing their endometrial structure. Possibly, therefore, this piece of endometrium may yet reach the ovary and give rise to symptoms.

So far it has given rise to none. But the patient, it is hoped, will remain under observation, and a further report may therefore be available at a later date.

The Origin of the Lutein Cells of the Corpus Luteum.

By Wilfred Shaw, F.R.C.S.

The origin of the lutein cells of the corpus luteum has for long been disputed. The old view of the metaplasia of the cells of the blood-clot found in the cavity of the follicle after ovulation was soon discarded, and at the present time two theories hold the field; that of von Baer, who attributed the origin of the lutein cells to the theca interna layer, and that of Bischoff, who considered the granulosa cells to be responsible for their origin. The essential difficulty in the solution of this problem for the human corpus luteum has been the scarcity of accurately dated specimens of young forms of the corpus luteum. In addition, even at the present time our knowledge of the normal histology of the ovary is incomplete and much of the work of early observers must be considered inaccurate. For, as Marshall points out, confusion existed between the atretic follicle and the young corpus luteum. In view of the enormous amount of work that has been done on this subject in a variety of different fields, the problem must be considered from a very broad aspect at the present time.

Comparative Morphology.

In the rabbit and in the mouse ovulation occurs at a fixed time after copulation. A graduated series of specimens showing corpora lutea at various stages of development can therefore be obtained, a method of deciding the origin of the lutein cells of the corpus luteum thus being afforded. This technique, which is the only reliable one for animal work, was first employed by Sobotta [1], who showed that in the mouse and in the rabbit the lutein cells were derived from the granulosa layer. Later, Marshall [2] confirmed this view as holding good in the case of the sheep.

Histology of the Mature Corpus Luteum.

It was pointed out by van der Stricht [3], who worked with the ovaries of the bat, that in addition to the large lutein cells, another series of cells can be seen. These cells are found at the periphery and in the hila of the convolutions and are much smaller and less numerous than the large lutein cells. Van der Stricht succeeded in demonstrating these cells in the human corpus luteum, and his observations were confirmed by Bühler, Seitz and others. The term paralutein cells has been applied to them by Pinto and American authors. These cells have been found in all specimens of corpora lutea out of some fifty that I have examined, and it seems clear that in the corpus luteum two types of cell are represented. There is no reason to believe that the paralutein cells are early forms of the large lutein cells, so it must be assumed that they have a different origin.

As there is no evidence that the theca externa cells undergo luteinization, it follows that the structure of the mature corpus luteum would lead one to believe that the theca interna cells develop into paralutein cells and that the granulosa cells give rise to the large lutein cells.

Differential Staining.

This view is borne out by the results of methods of differential staining. With ordinary stains—particularly with van Gieson's stain after fixation in absolute

alcohol—the two types of cell can be distinguished, but special methods are required to produce a sharp differentiation. It has been shown by Corner [4], and Solomons and Gatenby [5] that osmium tetroxide stains the cells of the theca interna far better than the cells of the lutein layer. It is not necessary to use osmium tetroxide, for Scharlach R, Sudan III and Nile blue sulphate bring out the differentiation very beautifully. These fat reactions depend upon the differences in the fat content of the cells of the two layers at various phases of the menstrual cycle. This is well seen in the corpus luteum during and shortly after menstruation, for at this phase the theca interna or paralutein cells contain fatty acids, while the large lutein cells contain neutral tat. Consequently Nile blue sulphate gives a very beautiful differentiation. Again, in the premenstrual phase, while the large lutein cells do not give a fat reaction, a neutral fat reaction is given by the paralutein cells.

Lastly, with paraffin-embedded sections the two types of cell can be differentiated with Twort's neutral red light-green method [6]. This is perhaps the easiest technique to employ. These staining properties of the two layers of cells afford further indirect evidence of their separate origin.

The Study of Early Forms of the Corpus Luteum.

The problem of the origin of the large lutein cells of the human corpus luteum would be solved with mathematical accuracy if a reliable series of young specimens of known dates were available. Such specimens are only rarely obtained, and at the present time one can only give the results of investigations of isolated specimens. I have obtained, up to the present, eight specimens of young proliferating corpora lutea—the oldest corresponding to the nineteenth day of the menstrual cycle.

These specimens show the mode of development of the corpus luteum from the follicle after ovulation has occurred. The outstanding feature of the early forms is the hypertrophy of the cells of the granulosa layer. These cells soon attain a great size and because of the denseness of the surrounding stroma they proliferate centripetally. Further, early specimens show the convoluted outline characteristic of the mature corpus luteum. The theca interna cells do not proliferate or hypertrophy beyond the state they have reached when ovulation occurs, and in these early specimens the two layers can easily be identified because of the great difference in size between the two sets of cells.

The study of this series of young corpora lutea quite clearly indicates that the theca interna cells become the paralutein cells of the mature corpus luteum and that the granulosa cells give rise to the large lutein cells.

If the follicle becomes atretic the histological picture is quite different. In this case the granulosa cells atrophy and finally disappear, but the cells of the theca interna layer hypertrophy in an eccentric direction much beyond the size they have attained in the case of a ripe Graafian follicle. Again, another important difference between the young corpus luteum and the atretic follicle is the character of the membrane between the theca interna and granulosa layers. In early forms of the atretic follicle a layer of hyaline material can be seen between them which soon attains a considerable thickness. In the case of the corpus luteum no hyaline tissue is deposited until degeneration of the corpus luteum begins at the time of the menstrual discharge. These differences between the young corpus luteum and the

atretic follicle have been emphasized because it is easy to understand that, owing to the hypertrophy of the theca lutein cells in the atretic follicle, this structure may be mistaken for a young corpus luteum unless its true significance is familiar.

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Section of Obstetrics and Gynæcology.

President—Mr. T. G. Stevens, F.R.C.S.

Gliosarcoma in a Full-time Stillborn Fœtus.

By D. J. Malan, M.D.

This was a case of full-time pregnancy. The patient, aged 28, had been married eight years and had had four children, the last two years ago. The labours were all normal, as also were the babies. Her last menstrual period was in August, 1924. Slight pains were felt on and off on May 23 and 24, 1925. On the evening of May 24 the pains became strong, the membranes ruptured, and the doctor tried forceps delivery but failed. She was admitted to hospital 1.30 a.m., May 25. On admission the fœtal heart was not heard, the fœtus was in the R.O.P. position, the os was not quite full and the patient was having no pains. She was given morphia and was delivered without forceps under an anæsthetic at 11.45 a.m. on the 25th. The fœtal head rotated during delivery into an R.O.A. The fœtus, a full-time 7-lb. female with considerable moulding of the head, was stillborn. There was nothing abnormal in the placenta or the amount of liquor amnii.

At the post-mortem examination the fœtus showed bilateral internal hydrocephalus and a slight tear of the tentorium cerebelli, but no evident hæmorrhage. In the left cerebral hemisphere was a rounded lump (8·5 by 7·5 by 6 cm.). Enclosing it, but easily separated from it, was the extremely flattened cerebral cortex (about 0·5 cm. thick), covered by smooth leptomeninges which were stained brownish in places. The lump was easily enucleated from the enclosing cortex. Its outer surface was lobulated and smooth. Its cut surface was in some places greyish-white or pinkish-grey, perfectly homogeneous and brain-like; in other places it appeared to be almost entirely composed of closely-packed minute red branching capillaries lying in a scanty groundwork of bluish-grey gelatinous tissue containing minute, opaque creamy-white specks and streaks. In these latter areas there were patches of red hæmorrhage which extended to the outer surface of the tumour. In the centre of the tumour was an area (2·5 cm. diameter) of irregular outline which was partly cavitated and partly composed of very soft, opaque, pale yellowish tissue.

Sections were taken from various parts of the tumour for microscopical examination. They showed a cellular gliosarcoma with areas of congestion, hæmorrhage and necrosis.

The interest of this case lies (1) in the rarity of the congenital tumour—I have been unable to trace another reported case in a fairly extensive search of the literature; and (2) in the fact that the cause of the stillbirth was probably the tumour and not the too early application of forceps.

Cases like these also illustrate the extreme importance of performing autopsies on stillborn fœtuses.

A Ten Weeks' Pregnancy Complicated by Rupture of an Acute Left-sided Pyosalpinx.

By D. J. Malan, M.D.

The patient, aged 37, had had two early miscarriages followed by a normal full-time pregnancy and labour eleven years ago. There was no history of any pelvic or other inflammation at any time. Periods were regular till April 26, 1925. Normal pregnancy followed with amenorrhœa till July 4, 1925. At 3.30 p.m. on July 4 the patient had a sudden severe generalized lower abdominal

pain, like severe labour pains. Great nausea and some vomiting were present. She felt very faint and there was some blood-stained vaginal discharge. The pains continued till admission that same night. On admission the patient was groaning with pain, referred chiefly to the left iliac fossa. Temperature 101° F. Pulse 96. The tongue was moist and furred. The abdomen was very tender, superficially and deep, and rigid all over. *Per vaginam* there was great tenderness in the left fornix, but no definite swelling could be felt. The uterus was enlarged to the size of a two months' pregnancy. The diagnosis of ruptured tubal pregnancy was made and laparotomy performed.

On opening the abdomen free pus was found in the abdominal cavity; there was no smell in the pus. The appendix region was normal. The uterus was the size of a ten weeks' pregnancy. The peritoneum was injected and there were fibrinous flakes on it. There were no fibrous adhesions anywhere in the pelvis. The left Fallopian tube was found to have a perforation (4 cm. wide) on the posterior aspect, 1 cm. from the fimbriated extremity, with pus issuing from the rent. The outer surface of the tube was covered by injected, pinkish-yellow peritoneum with patches of greyish fibrinous membrane scattered over the distal two-thirds. The Fallopian tube was removed and the abdomen closed, a drainage tube being left in. The day after the operation the patient miscarried.

Recovery was slow, being complicated by thrombo-phlebitis in both legs. But the patient was eventually discharged as fit on August 16.

Microscopically, the condition of the Fallopian tube was that of an acute, purulent inflammation with areas of necrosis, and the post-operative diagnosis of ruptured acute pyosalpinx was confirmed. Unfortunately no culture was made from the pus.

The interest of the case lies in the rarity of the condition and in the difficulty in diagnosing the real state of affairs before operation.

I am much indebted to Dr. Russell Andrews for permission to report these cases, which were under his care; and also to Dr. W. W. Woods, of the Pathological Institute of the London Hospital, for the pathological reports, &c.

Discussion.—Dr. H. Russell Andrews said that intraperitoneal rupture of a pyosalpinx was a very rare occurrence, and gave details of such a case in his own practice.

Dr. J. S. Fairbairn said he agreed as to the extreme rarity of the rupture of a pyosalpinx into the peritoneal cavity. He had never had a case of his own in which this accident had occurred, but he said that one had occurred in the gynæcological ward at St. Thomas's Hospital during his term of service there. The patient was under his late colleague, Dr. Walter Tate, and, as she was suffering from no acute symptoms, she was given the usual bath on admission to the ward. During the cleansing process, acute abdominal pain came on and became so severe that Dr. Tate was summoned, and some hours later he performed an emergency abdominal section. Pus was found free in the pelvic peritoneum coming from a ruptured pyosalpinx.

Dr. Louise McIlroy said that she had had a case of pyosalpinx which was sent into hospital by the patient's doctor as one of ectopic pregnancy with sudden rupture. The diagnosis was confirmed and operation performed. The tube was distended with pus and a small opening was found from which drops were escaping. Subsequent examination of the tube contents revealed the presence of gonococcal organisms, which as a rule were difficult to find in the suppurative lesions of the tube.

The Treatment of Puerperal Infection by Intra-uterine Injections of Glycerine.

By H. J. Phillips, M.B., B.Ch., B.Sc.

My paper to-night will deal mainly with the results obtained from the treatment along certain definite lines of a series of cases of puerperal infection.

These cases were treated at Monsall Hospital, Manchester, under the Public Health Department of that city [1].

In Monsall Hospital a block of twenty-two beds is set aside for the reception of puerperal cases, and it is the only institution in the city which now admits them. The cases are taken from a population of over 700,000 and the annual admissions vary from 90 to 120. No cases are refused and every encouragement is given for them to be sent in as early as possible. In my experience of the treatment of puerperal infection, both in the Monsall and other institutions, I have been impressed by the enormous amount of extra-uterine injuries from which many of these patients suffer and the terribly septic condition of these injuries on admission to hospital; I speak of the injuries of the genital tract situate high up in the vagina, not of the torn perineum.

In these cases bimanual examination alone can convey a very erroneous idea of the existing conditions. On exposing the vagina we frequently find the remains of a lacerated cervix covered with foul sloughs lying in a torn, actively suppurating vagina which is teeming with micro-organisms.

Under these conditions the uterus may easily become infected, without other cause, either directly into the uterine wall or by way of the cervical canal to the endometrium. From either of these situations or from both the infective process may spread anywhere if the local defences fail. However harmless the micro-organisms may be in the acid secretions of the vagina, they may rapidly become pathogenic when in such a suitable medium for growth as the alkaline lochia or the body tissues.

I think that infection of the uterus, especially of the wall, takes place in this way much more frequently than is generally recognized. However, whatever view is taken, the fact that the possibilities of early and gross infection of the uterine wall are so great, demonstrates the futility of depending for good results on mere drainage of the cavity or on attacking the endometrium.

From these considerations I thought that if, in addition to allowing free drainage of the cavity, some method could be adopted by which the uterine wall could be helped to drain itself, by promoting a flow of lymph through it, into the cavity instead of into the patient's organism, spread of an acute local infection might be prevented.

Irrigation, with the stitching in of a tube, is not good, and the application of hypertonic solutions is not satisfactory, for they cannot be kept for long in contact with the uterus.

Some time ago I had the opportunity of seeing glycerine used *in utero* for this purpose, and that use of it appealed to me as a possible solution. Glycerine is a powerful tissue dehydrant, it is viscid in nature, will remain for a considerable time in contact with the tissues, and can be delivered slowly and evenly all over the interior of the uterus without the slightest danger to the patient. This was given a good trial in Monsall Hospital and the results have been very satisfactory.

Technique of Treatment [2].

The patient is placed in the gynæcological position and the usual toilette of the external genitals is carefully carried out. The vagina is then exposed by passing a posterior speculum and an anterior retractor [3]; each individual lesion is thus brought clearly into view and must be carefully attended to. Finally, the cervix and cervical canal are cleaned and the uterus is now ready to be approached.

A 10 c.c. record syringe is filled with pure glycerine; to the end of the syringe is attached a long terminal-eyed soft rubber catheter, size 6. The catheter is introduced into the uterus and pushed right up to the fundus; the glycerine is then slowly injected, and in this way an even spread over the uterine mucosa is obtained. The catheter is left *in situ*, a piece of sterile ribbon-gauze is tied round the free end of the catheter which is pushed into the vagina, the gauze protruding beyond the vulva. In this way the catheter may be removed in six hours' time by simple traction on the gauze.

In the majority of cases my patients were thus drained once daily, the more severe cases twice. In the first 100 cases the average number of applications per patient was seven. The treatment was continued until all signs of active inflammation had subsided.

One great advantage of this method is that the local condition is well exposed and can be thoroughly well cleaned daily. It is extraordinary how rapidly these lesions heal when attended to in this way, the one lesion that does cause a great amount of trouble is the deep paravaginal abscess so frequently met with in the badly torn vagina. Further, the interior of the uterus can be approached easily without exerting any tractive or other force on the cervix, a procedure which is always dangerous when dealing with a septic patient.

The passage of the catheter and the injection of the glycerine will help to reveal the presence or absence of pus *in utero*. This condition is very frequently met with in the septic puerperal uterus; it was present in over 50 per cent. of my severe cases, usually only in small quantities. But in one case I recovered over 6 dr. of pus on the first examination after admission, and some was lost; in another case I recovered nearly 3 dr.; ½ to 1 dr. is a common quantity.

Most causes of obstruction to free drainage in the puerperal uterus are well known (malpositions, distended bladder and rectum, &c.), but the factor that is not nearly sufficiently well recognized consists in extensive actively suppurating extra-uterine injuries involving the cervix and producing inflammatory occlusion of the cervical canal. The reason is that the presence of the lesions is not recognized because the vagina is seldom exposed until the patient arrives in hospital. There is a profuse purulent vaginal discharge, and this is frequently taken as an indication that the uterus is draining well, whilst in reality the discharge is coming from suppuration high up in the vagina. The uterus is lying soft and inert, its cavity filled with purulent material.

As long as the catheter remains *in situ*, the cervical canal will remain patent and the purulent material will have an exit round it. The introduction of the glycerine will tend to produce uterine contractions; these may expel the catheter, but at the same time will help to expel any septic débris that may be present. I regard the early expulsion of the catheter as a favourable sign.

In 130 cases that I have treated by glycerine drainage, to which I shall refer as lymph-drainage, I have never once explored the uterus, except for primary hæmorrhage in cases of septic abortion. In many of the cases there have been fragments of membrane, placenta or decidua *in utero* on admission, sometimes of considerable size, but these fragments have never failed to come away in the manner just indicated.

In order to give a fairly accurate idea of my results I will compare two series of cases, all being those of patients who recovered.

(1) A series of eighty-seven cases treated by lymph-drainage of the uterus.

(2) A series of 110 cases immediately preceding the former.

The cases in the two series were all drawn from the same district and were of the same type.

Before lymph-drainage of the uterus was begun at Monsall cases of puerperal infection were treated along three main lines. The milder cases were treated expectantly, that is, with vaginal douching, Fowler's position, quinine, &c. The more severe ones were treated with anti-streptococcic serum or by curettage. I took a series of 110 cases, so that I should embrace some treated by each method.

Of these 110 cases, 88 were treated expectantly, 17 were treated with anti-streptococcic serum, and 5 were treated by curettage. There was no selection of cases whatever, the 110 cases and the 87 cases form a consecutive series.

Of the 110 cases, treated as indicated above, 29 per cent. developed complications after coming under treatment; in 11 of them pus was formed and this led to operation being required.

Of the 87 cases treated by lymph-drainage only 13·7 per cent. developed complications, less than half the percentage in the other series.

Out of this 13·7 per cent. cases *only one developed pus.* This, I think, is a most striking figure. I consider this reduction in the incidence of complications as the strongest point in favour of the treatment, and the following tables exhibit the complications in some detail.

(1) TABLE SHOWING COMPLICATIONS IN THE PATIENTS WHO RECOVERED.

Treatment	Number developing complications	Percentage	Number developing pus
Expectant, 88 cases ...	21	23·8	6
Anti-strep. serum, 17 cases	7	41·1	2
Curettage, 5 cases	4	—	3
Total, 110 cases ...	32	29·0	11
Lymph-drainage, 87 cases ...	*12*	*13·7*	*1*

(2) TABLE SHOWING ANALYSIS OF COMPLICATIONS.

Complications	110 cases treated on ordinary lines	87 cases treated by lymph-drainage
Pelvic abscess	3	Nil
Parametritis	1	,,
Parametritis and abscess	1	1
Salpingitis	4	1
Salpingitis and pyosalpinx	1	Nil
Salpingitis and phlegmasia	Nil	1
Phlegmasia, one leg	2	2
Phlegmasia, both legs	2	Nil
Phlegmasia and cystitis	1	,,
Phlegmasia and pyæmia	1	,,
Pyæmic abscesses	5	,,
General peritonitis	1	,,
Cystitis	1	3
Pyuria...	2	Nil
Nephritis	1	,,
Oöphoritis	1	,,
Lobar pneumonia	1	,,
Mania...	2	,,
Arthritis	2	2
Mastitis	Nil	1
Facial erysipelas	,,	1
Percentage	*29* %	*13·7* %

With reference to the last two complications under lymph-drainage, the case of mastitis and the case of facial erysipelas, the first was a direct infection through a cracked nipple and the second was an acute exacerbation of a chronic condition.

The next point to consider is the mortality. The percentage mortality in the first 100 cases treated by lymph-drainage was 13 per cent. This is the lowest figure recorded in the institution for many years; but although it is much below the figure for some years it is not very much below that for others. No conclusion of great value can be drawn from this figure, for in this series of cases the work being carried out on the treatment of the acute blood infections was in its very early stages and, further, many other factors are always at work over which we have no control. For example, cases of puerperal infection are frequently admitted to hospital with the primary condition complicated by pneumonia, general peritonitis, acute cardiac conditions, &c. The success of any line of treatment of puerperal infection should be measured rather by its effect on the local condition and the acute general infections arising therefrom than by the number of patients who die after admission to hospital. It is to be noted that of the thirteen patients who died in this series now being considered, all died from some condition well established before coming under treatment.

There is one other thing that I wish to mention, which is important from an economic point of view and all-important to the patient.

Since lymph-drainage of the uterus has been started at Monsall, the average stay in hospital of patients who recover has been very greatly reduced. This reduction I attribute to the shortened period of initial illness and to the absence of subsequent complications. For three years, up to the end of 1923, the average stay in hospital of patients who recovered was 38 days. The average stay in hospital of the 110 cases quoted above was 41·5 days, that is, much the same as the average for the three years just mentioned. The average stay in hospital of the cases who recovered and who were treated by lymph-drainage was *26·2 days*, and this has since been maintained.

Again, it is most gratifying to note the relief from pain and the ease which the patient experiences after treatment has begun; also the rapid improvement in her clinical condition accompanied by a quick fall in the temperature and pulse-rate. Further, in a number of severe cases I estimated the bactericidal power of the blood on admission and at intervals after lymph-drainage had been instituted; in every case there was a marked rise which was maintained.

Acting on the suggestions of Dr. Colebrook, two lines of treatment have been adopted for the acute blood infections:—

(1) The intravenous injection of arsenical drugs as a direct bactericidal agent.

(2) The transfusion of immunized blood as a help to the patient's own defensive mechanism.

The arsenical drug which gave the best results was novarsenobillon. It was administered in two ways:—

(1) Small doses of 0·1 to 0·15 grm. repeated every 24 to 48 hours up to a maximum of six doses.

(2) Large single doses of 0·6 grm.

The results of the repeated small doses were disappointing. In no case did the patient show any marked clinical improvement; in one case, however, there was a marked increase in the bactericidal power of the patient's serum. In no case did the small repeated doses interfere with the patient's leucocytic efficiency.

The results of the treatment with the large dose have been much more satisfactory. Up to the time of writing of this paper only three cases have been treated in this way, but all three showed a dramatic improvement, two of them recovering. In one case the bactericidal power of the patient's whole blood and of the serum was estimated before and six hours after the injection of 0·6 grm. of novarsenobillon; the results are given below.

In the case of the whole blood, 50 c.mm. of blood were inoculated with a known number of virulent hæmolytic streptococci and incubated for three hours; this inoculated blood was then explanted into the blood-agar and incubated for twenty-four hours; the surviving colonies were then counted.

No. of strep. implanted in 50 c.mm. of blood	No. surviving	Percentage killed
Before Injection.		
96	46	55 per cent.
192	358	—
Six Hours after Injection.		
108	nil	100 per cent.
216	27	89 ,,

It is interesting to note that six hours after the injection not only is the percentage of streptococci killed greater, but the same quantity of blood is capable of dealing with a much larger number of organisms than it was before.

In the case of the serum, before injection 1 c.c. of serum killed 480 cocci, six hours after injection 1 c.c. of serum killed over 300,000 cocci. The ultimate results of immuno-transfusion alone have not come up to expectations; in all bad cases they do good, but the effect in my cases was transitory; if used alone, two or three

transfusions should be given at intervals of 48 to 72 hours; 500 to 600 c.c. of blood should be given at each transfusion.

The results of a single transfusion of 500 c.c. of immunized blood in two patients are given below. Both were cases of hæmolytic streptococcic septicæmia.

CASE 1.

Blood before transfusion :—	
Number of cocci per c.c.	uncountable
Twenty-four hours after transfusion :—	
Number of cocci per c.c.	*10*
Forty-four hours after transfusion and thirty minutes before death :—	
Number of cocci per c.c.	uncountable

CASE 2.

Blood before transfusion :—	
Number of cocci in 0·5 c.c.	uncountable
Twenty-four hours after transfusion :—	
Number of cocci in 0·5 c.c.	uncountable, but less
Forty-eight hours after transfusion :—	
Number of cocci in 0·5 c.c.	*25*

This last patient was apparently making a splendid recovery, her clinical as well as her blood condition was greatly improved, when she suddenly collapsed and died from pulmonary embolism.

Conclusions.

Many still hold very strongly to the view that there should be no interference whatever with the septic uterus on account of possible dangers to the patient. Using the technique described, I, at any rate, have not met with a single mishap in 130 cases, whilst on the contrary every patient apparently benefited by the treatment.

The absence of pus formation and of local inflammatory complications indicates that the dehydrating action of the glycerine helps to stop direct spread of local infection and thus tends to minimize the dangers of subsequent general blood infections or infections of the lymphatics.

Much work has yet to be done on the treatment of the septicæmias, but the results obtained from the exhibition of novarsenobillon in large doses is distinctly hopeful and the use of immuno-transfusion is a help, especially so in those cases in which the patients have suffered from severe hæmorrhage.

Finally, everything possible should be done to bring the cases under treatment early, especially those cases where there have been difficult labours or instrumental deliveries in which the possibility of extra-uterine damage is great.

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Some Laboratory Investigations in Connexion with Puerperal Fever.

(*Carried out, for the most part, in collaboration with Dr. R. M. Fry.*)

By LEONARD COLEBROOK, M.B., B.S.Lond.

(*Assistant, Bacteriological Department, Medical Research Council.*)

IN this paper I propose to put to you a few of the questions which occur to everybody in connexion with puerperal fever, and to attempt to show how far laboratory evidence is able to go at present in supplying answers to them. It will be necessary to limit myself to rather a brief consideration of most of the problems, and to evidence obtained for the most part by my colleagues and myself at St. Mary's Hospital.

Question 1.—*What microbe is responsible for most of the puerperal infections?* There would seem to be no reason to doubt that the hæmolytic type of streptococcus is the responsible agent in the great majority of the septicæmic cases. Of the eighteen fatal cases we have investigated during the past three years, hæmolytic streptococci were recovered from the blood during life in sixteen, staphylococci in two (both abortion cases); while of eight non-fatal cases, hæmolytic streptococci were recovered from the blood in four, *Bacillus coli* in three and *Streptococcus viridans* in one.

It is often said that blood cultures may be negative in cases dying of puerperal septicæmia. One cannot deny that it may be so, but it has not been my experience. Bacteriological technique has been improving steadily, and it is probable that small blood infections are now sometimes recognized which would have been missed ten years ago.

As to whether the hæmolytic streptococci play a predominant part in the localized puerperal infections one cannot speak with quite so much assurance, but our experience leads us to think that they do. Swabs taken with care from inside the cervical canal in non-septicæmic febrile cases usually give an almost pure culture of this organism. If they do not, one generally finds that the patient's symptoms are very slight and that the temperature is down within forty-eight hours. The predominant organisms found in such mild cases would seem to be diphtheroid bacilli, of several types, and staphylococci.

Question 2.—*Is there a special type of streptococcus peculiar to puerperal fever—a distinguishable "Streptococcus puerperalis"?*

It has been maintained by Dr. L. Mackey [1] in this country that this is the case; that he can differentiate his "*Streptococcus puerperalis*" from others of the *pyogenes* type met with in septic wounds generally; and that the organism he describes is not to be found in connexion with any other infections. If that is so it is of course a very important point from the epidemiological standpoint. The distinction made by Dr. Mackey rests upon certain niceties of bacteriological classification. I do not propose to discuss these in detail here, but shall only express my opinion—which I think is shared by most bacteriologists—that the characters by which Dr. Mackey claims to distinguish the puerperal streptococci, viz., the form of the individual cocci and of their colonies, the fermentations produced by them with different sugars, &c., are quite inadequate for the purpose.

There may be a distinct streptococcus of puerperal fever, but I think its existence has not yet been demonstrated. Dr. Fry and I have made some preliminary investigations on the matter by means of agglutination tests. The work is not yet finished, but the results obtained seem likely to show that the twenty-four strains we have dealt with do not constitute by any means a homogeneous group.

The whole question of the classification of streptococci is an extremely difficult one, and we shall do well to hold very lightly any views about hard and fast groupings. Especially is this the case in view of the support recently given by certain German workers [2] to the suggestion that the several different types of streptococci are really only variant forms of one organism, produced in response to different environments; and that it is possible to transpose them at will. Hæmolytic streptococci are said by these workers to have been developed from pneumococci (by treatment with optochin), and then to have been changed again into the "*viridans*" type (by passage through the peritoneum of mice). If these findings are confirmed and accepted it will be necessary to revise all our views about the specificity of streptococci.

Question 3.—*What is the source of the infection in puerperal fever?*

The possibility of direct transmission of the streptococcus by those in attendance on the patient has been sufficiently emphasized, and I have nothing new to tell you about it. As to the possibility of infection from the vagina or rectum, I shall say only this—that hæmolytic streptococci can rarely be cultivated from the rectum of

normal women, and it is generally taught that they do not occur in the vagina. On this latter point I have no first-hand evidence. It is sometimes suggested that in certain circumstances the non-hæmolytic streptococci, which are frequently present in the vagina, may be transformed into the hæmolytic type found in puerperal sepsis, but I know of no evidence pointing to such a transformation. As mentioned above, certain German workers [2] claim to have transformed the hæmolytic to the "*viridans*" type, but not, I believe, vice versa, although there would seem to be no *a priori* reason why it should not be done.

As a matter of fact, I would suggest that there is nothing remarkable in the circumstance that a certain percentage of parturient women become infected by the hæmolytic streptococcus. A large proportion of all the open wounds in our surgical wards and casualty departments are infected with streptococci precisely similar to those of puerperal fever, so far as one can determine. It is probable, therefore, that this microbe is very widely distributed, at any rate among our crowded populations. Nor is it surprising that this should be so, when we reflect that hæmolytic streptococci are frequently to be found in the upper respiratory tract of adults, and have recently been isolated from the tonsils in a large percentage of children by American workers.

Although *non-hæmolytic* streptococci are very commonly present both in the rectum and vagina, and must therefore very frequently have access to the tissues injured in labour, they very seldom seem to give rise to trouble—and very rarely indeed to septicæmia. This is probably to be accounted for by the fact that these types are found to be more easily killed by leucocytes than the hæmolytic strains of the organism.

Question 4.—Is there any evidence that a lowering of "resistance" to streptococcus by the processes of labour plays any part in the incidence of puerperal infections?

In the last few months we have examined the blood of a number of women during normal labour and the first three or four days of the puerperium. The power of these bloods to kill hæmolytic streptococci was taken as an index of their "resistance" to that microbe. Certain technical difficulties we have encountered make it necessary to speak rather guardedly as to the results, pending further work on the subject, but the indications are that the "resistance" of women in and after labour tends to be higher rather than lower than that of healthy adults generally. Several times we have found it raised far above the normal level. There would appear to be a close relationship between the power of the blood to kill streptococci and its leucocyte content,[1] and we were surprised to find how often a leucocytosis occurred during or shortly after a normal labour. In one case the count was 40,000 in the first stage of labour; and counts of 15,000 to 25,000 were commonly obtained. The bactericidal power was almost invariably much above the normal in association with these high counts. We know nothing yet as to how and why this great accession of leucocytes to the blood-stream is brought about; but I think there can be little doubt of this—that it must serve to protect many women from puerperal infections in the most dangerous period, i.e., the first six hours or so after labour.

One practical suggestion comes out of this work; it may have been made and acted upon long ago, but I have not heard of it. It is this. In cases which, by reason of difficult instrumental delivery or other circumstances, are regarded as in danger of sepsis, it might be well to do a leucocyte count immediately after labour (or during labour), and if the figure is not above, say 12,000, to induce a leucocytosis by means of an intramuscular injection of nuclein (Parke, Davis & Co., Solution No. 1, 2½ c.c.). Such an injection will usually double or treble the number of leucocytes in circulation within four or five hours.

[1] This, of course, is not an original observation. It was made long ago by Hahn [3] in connexion with staphylococcus, *Bacillus coli* and *Bacillus pyocyaneus*.

Question 5.—What are the factors which determine whether a puerperal infection of the genital tract remains localized to the pelvis or develops into a "blood infection"? And along with this question we may consider also, what are the factors which determine the course of a "blood infection"?

To discuss these fully it would be necessary to deal with at least four possible factors, viz.:—

(*a*) the "virulence" of the infecting streptococcus. In spite of all the work that has been done, and all that has been written, upon this factor, no clear decision has been reached. This, I take it, is in part because the term "virulence" is itself an unfortunate one; and also because experimentation has been confined too much to one stereotyped plan, using animals (rabbits and mice) far removed from man instead of studying the effects exerted by the streptococci upon human blood and the human organism;

(*b*) the magnitude of the original infection by streptococci—with which are associated—

(*c*) the local conditions at the seat of infection, which favour or hinder the rapid development of a massive infection. Some reference will be made to this factor later in connexion with local treatment;

(*d*) the patient's defensive mechanism. The work we have done at St. Mary's has reference chiefly to this last factor and will perhaps help us to speculate upon the questions at issue.

Let us begin at the beginning, that is, at the moment when a few streptococci become implanted upon the lacerated uterine or vaginal tissues during labour. Favourable circumstances will probably permit some of them, either at once or within a few hours, to be carried into the blood-stream. What will happen to them there? Our laboratory experiments on the killing power of normal blood teach us that when such blood is infected with a moderate number of streptococci, say 200 to 1,000 per c.c., and kept slowly moving in the incubator, it will kill off every microbe within two or three hours.[1] And blood enriched with an abnormal number of leucocytes, as is that of many women in labour, will kill off completely a much larger number of cocci. The conditions in these experiments are not very different, I take it, from those in the smaller capillaries where the blood-stream is slowed, and it therefore seems legitimate to suppose that many such small, early invasions of the blood-stream are successfully dealt with by the patient. Probably they do not even occasion a rise of temperature. But a different situation will arise if for any reason the patient's blood is not functioning like normal blood, that is to say if her leucocytes are either numerically deficient or are individually inactive. Some of the streptococci might very well survive in those circumstances, and, lodging in some situation where they are partly sheltered from the blood-stream (as Sir Almroth Wright has shown them to do in the case of typhoid septicæmia), might find their opportunity to multiply and give rise to an ever-increasing "blood infection."

This is speculation, and I do not want to build too much upon it. I cannot positively affirm that this condition of depleted leucocytic defence actually does arise during labour or the first hours of the puerperium, but I suspect that it may. It has not yet happened to us to examine the blood of a woman at this time who afterwards developed puerperal fever. Nor can I tell you at present whether special circumstances, such as long anæsthesia or the exhaustion of a difficult delivery, are prone to be followed by such an impoverishment of the leucocytic defence. We have, however, some information which would seem to have an indirect bearing upon this speculation.

In 1908 Shattock and Dudgeon [4] showed that the activity of the leucocytes as judged by their phagocytic capacity was much reduced in some cases of puerperal

[1] This slow motion is important—it ensures intimate contact between the microbes and the leucocytes.

septicæmia. That observation has since been abundantly confirmed by Sir Almroth Wright [5] and his colleagues [6] at St. Mary's Hospital. Indeed, one may say now that in septicæmia due to hæmolytic streptococci (not always in other septicæmias) this depression of leucocytic functions is the rule, and that it becomes more and more complete as the disease progresses. For practical purposes one may regard puerperal septicæmia as a disease of leucocytes—at any rate the evidence suggests that it is the injury done to these cells which makes it so fatal.

Analysis of this change in the leucocytes has made but little headway. We know that a minor degree of it (e.g., a drop to 60 or 70 per cent. of the normal activity) is frequently associated with a severe localized puerperal infection—as with some other acute infections. Continuance of that condition does not as a rule lead to septicæmia. We also know that extreme degrees of this leucocytic inactivity are associated with quite distinct morphological changes in the cells, their protoplasm becoming filled with very fine granules. What the condition depends upon we do not know—whether the cells are exhausted by their attempt to stem the flood of infection; or, as seems rather more likely, they are poisoned by bacterial toxins; or whether, again, their degeneration may be traced to the parent tissue.

Efforts to demonstrate a toxin produced by streptococci having a special destructive affinity for leucocytes have so far been unsuccessful. It may be that only certain strains produce it.

Question 6.—What is the significance of the finding of streptococci in the blood? Are we to regard them as just thrown into the blood-stream from a local focus, or are the microbes actually multiplying in the vascular system?

Again I cannot give you a definite answer, but such facts as I have are as follows: In a fatal case the number of streptococci cultivated from the circulating blood steadily increases until death. One case I recall in which the septicæmia was associated with general peritonitis: on the third day of fever there were two streptococci per c.c. of blood, on the fourth day 100, on the fifth 1,000. The patient died on the sixth day. That, I think, is the usual sequence of events. You will notice that the numbers, although they indicate a very formidable infection, are very small in comparison with the growth of such streptococci in nutrient medium outside the body. Moreover, it is remarkable that the number in the blood twenty-four hours before death (1,000 per c.c.) is infinitely less than would have been attained in that same blood incubated outside the body.

Apparently, then, while there is some suggestion of multiplication in the blood-stream, this never goes on unchecked even in the last hours of life. By what mechanism it is checked I do not know.

(It is well to bear in mind that figures such as I have quoted above may sometimes be misleading—they represent the number of colonies growing in an agar plate, but each colony may arise from a chain of streptococci or from an agglutinated mass.)

One point of a practical kind I should like to make in connexion with this question as to the number of streptococci in the blood. I would suggest to you and to my fellow bacteriologists that we should no longer be content with obtaining a "positive" or "negative" report on a blood culture in a case of septicæmia. The bacteriologist is put to very little extra trouble to tell you approximately *how many* microbes there are per c.c. of blood; and that result is obtained with very little delay. There are two advantages in adopting this plan. (1) The information gained is of considerable value in forming a prognosis. Recovery from septicæmia, when only very few streptococci are found in the blood (1 to 10 per c.c., for example), is not uncommon, but I have only once known it to occur when 50 or more per c.c. were found. (2) It helps us to judge of the effect of any treatment we adopt. In forming that judgment it is desirable to know, in connexion with every case, whether we were dealing with a heavy or a light "blood infection," since, as I have just said, some of the light

cases recover spontaneously. And, further, when quantitative blood cultures are performed before and a few hours after any particular treatment, we may get a valuable clue as to the immediate effects of that treatment.

Question 7.—What should be the aims of treatment, and by what methods may we expect to achieve those aims?

May I say first that it is far from my intention to attempt to lay down the law in this very difficult matter; I want simply to show in what directions our laboratory investigations seem to point. With regard to the problem of how best to deal with the local infections of the genital tract, I would suggest that we look back to the late war and consider whether the great experience we then had of wounds infected with hæmolytic streptococci has not left us a clue to the treatment of the puerperal wounds.

Early in the war we learned at great cost that wounds infected with hæmolytic streptococci and containing also injured tissues and blood-clot could not safely be left to themselves. The laboratory work of Sir Almroth Wright [7] gradually made clear to us why this was. Behind the superficial coagulum which forms over the wound when bleeding stops, there occur little collections of serous fluid squeezed out of contracting blood-clots. In these fluid pools, and in the injured tissues deprived of their blood-supply, only one or two kinds of microbes can grow, notably the streptococci and staphylococci, and their growth at first is partially restrained. After a few hours, however, a change occurs in the now stagnant fluid, due to the disintegration of the injured tissues and of the leucocytes which have gathered to attack the microbes. This change is such as to deprive the serous fluid of whatever restraining influence it had upon the growth of streptococci and to make it a highly congenial culture medium for every kind of microbe that was implanted at the time of injury. From this time onward the conditions are more and more favourable to the microbes; more and more unfavourable to the patient. I would submit to you that the condition of wounds of the genital tract infected with streptococci during labour is in some measure similar to those I have sketched. The blood-clot is there, and often injured tissues, sometimes also devitalized placental tissue. Happily there is not quite the same tendency to drying of the surface of the infected tissues, but it will immediately occur to you that the worst cases of puerperal fever are just those in which the lochial flow is completely suppressed—may it not be that they are the worst *because* the flow is suppressed?—and I imagine that in many other cases the flow is partially suppressed.

The conclusion which Sir Almroth Wright drew from his analysis of the sequence of events in the infected wound was that stagnation of the fluids in and about the injured tissues is the thing we have to fear; and that to avoid such stagnation by the frequent application of chemical agents calculated to promote a flow should be the first aim of treatment.

The other outstanding lesson of the war in respect of infected wounds was, I think, the success of the Carrel-Dakin method of intermittent irrigation. This was introduced of course as a means of directly killing the microbes in the wound by an antiseptic. It soon became clear that that did not happen—at any rate on any large scale—and yet the wounds did well. The work of my colleague, Dr. Alexander Fleming [8], has thrown a flood of light on this. He has shown why we cannot expect to sterilize a deep wound by the direct action of any antiseptic; he has shown also that some antiseptic solutions—and, best of all, the hypochlorite solutions, such as Dakin's—induce an abundant flow of fluid through the infected tissues. There is little doubt that the beneficent effect of the Carrel-Dakin method was obtained in this way.

By both of these avenues, therefore, we arrive at the same conclusion, viz., that what we have to fear in an infected wound is stagnation of serous and tissue fluids, and the obvious remedy is to promote a continual flow through the infected tissues.

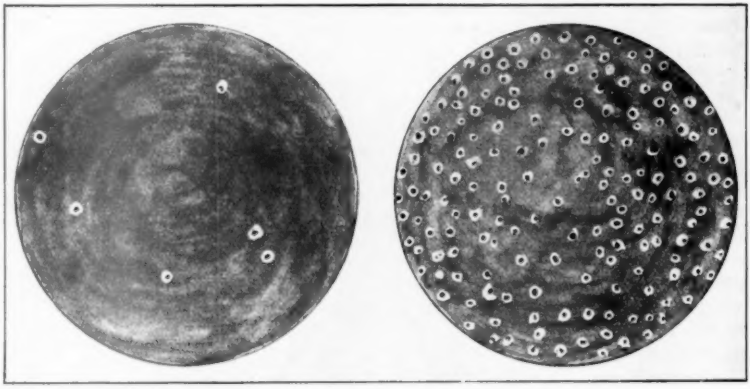
That, I take it, is the aim of the treatment so enthusiastically advocated by Dr. Remington Hobbs [9].

The glycerine which he instils into the uterus is not to be regarded as an antiseptic (streptococci are almost indifferent to it), but it serves to produce a flow through the infected tissues to the exterior—and I imagine that the muscular contraction which is set up further assists in counteracting stagnation. Hypertonic salt solution, or Dakin's solution, would have a similar effect in promoting a flow, but the glycerine has an advantage over these in respect of its viscidity, which allows it to be retained in contact with the tissues for a longer time. In a very foul case, e.g., one with decomposing retained products, I should expect one of these other fluids, frequently applied on the Carrel-Dakin plan, to be more effective.

I have had the pleasure of seeing a good deal of Dr. Hobbs' work myself, and I cannot help thinking that the results he has obtained—and those of which we have heard to-night from Dr. Phillips—go far towards establishing the lymph-drainage

RESULT OF A BACTERICIDAL TEST WITH HÆMOLYTIC STREPTOCOCCI.

Normal man's blood. Septicæmic blood.



390 streptococci were implanted in each blood.

system as a notable advance in the treatment of these infections. If they did nothing more they would surely have disposed of the contention that it is dangerous to interfere *in any way* with an infected uterus. We should not adopt that attitude with regard to any other septic focus, and I think we shall agree that the results of non-interference—although they are probably better than those obtained by the earlier methods (curettage and application of strong antiseptics)—are still not so satisfactory that we can rest content with them. Intra-uterine drainage is probably not necessary for all cases, but I am disposed to think that Dr. Hobbs is right when he preaches that it would be far better to carry out the treatment on all, rather than wait for many of them to get into grave danger.

Now as to the treatment of the septicæmic cases, may I remind you of the circumstances which confront us when we undertake this task. Firstly, as to the magnitude of the infection. Not infrequently a case of this kind on admission to hospital, on about the fifth or sixth day of the puerperium, will show in a quantitative blood culture not less than 50 to 300 streptococci per c.c. of blood, that is to say, the patient has from 500,000 to 3,000,000 cocci at least constantly in circulation; leaving out of account all those in the pelvic tissues and other internal organs. Secondly, as to her capacity to deal with this situation. I have already told you that the efficiency

of the leucocytes in such cases is very much below par, as gauged by phagocytic tests. The same thing is indicated by testing the power of the blood to kill streptococci. The figure illustrated (p. 37) shows the result of such a test. A similar number of cocci (390) was implanted into a sample of blood from a septicæmic patient and into normal human blood. After two hours' incubation, a measured volume of each of these infected blood samples was taken and mixed with melted agar in order to determine how many cocci had survived the bactericidal action. You will see that only 6, i.e., 1·5 per cent., have survived and grown into colonies in the case of the normal blood, as compared with 163, i.e., 42 per cent., in the case of the septicæmic blood.

Clearly, then, we are up against a very desperate situation; a very large infection and the patient's normal mechanism for dealing with it almost out of action. In these circumstances what is to be the aim of our treatment? I would submit that we must seek to do one of two things: (*a*) either to convert the whole of the patient's blood into a medium in which the streptococci cannot live, and, of course, maintain this condition for a sufficient length of time, or (*b*) we must free the leucocytes from whatever agency it is which is reducing them to impotence.

If there is yet another way in which the situation may be retrieved, much of what follows may lose its force, but the facts available at present do not seem to suggest any other way out. We cannot know, of course, all the factors concerned in the development of septicæmia or in the mechanism by means of which some cases recover from it, but this much seems highly probable—that in the mechanism of recovery the leucocyte is the predominant factor.

Accepting that conclusion until such time as fresh evidence brings us to doubt it, let us consider whether we have any remedies which might achieve either of the aims we have stated, viz, a big killing off of streptococci or the relief of the leucocytes from the paralysing influence which affects them. It will be convenient to deal first with this latter possibility—the relief of the leucocytes—for the simple reason that I know of no remedy which promises anything in this direction at present. I am not hopeless about the ultimate finding of some such remedy, but it is not likely to be found until we know a good deal more about the *causation* of the leucocytic inefficiency than we do at present. The cure of streptococcal septicæmia might well prove to be along that road.

There is much more to be said about remedies which have been introduced with the intention of directly killing streptococci in the vascular system. In that class will be found most of the drugs which have been tried in the past forty years, perchloride of mercury, flavine, rivanol, eusol[1] and quinine.

With regard to all these drugs, it may be said that the knowledge we have gained in the laboratory during the last few years has enabled us to understand why they fail to achieve a bactericidal effect when introduced into the blood-stream. Sir Almroth Wright's work in connexion with optochin [10] gave prominence to the fact that many "antiseptics" fail to kill microbes in blood because their chemical energy is spent immediately upon the serum proteins, e.g., perchloride of mercury, formalin, iodine (optochin he found was an exception to this). Later Dr. Alexander Fleming [8], in a striking series of experiments, showed that other antiseptics, although they have not much affinity for the serum proteins, combine with and destroy the cells of the blood, with disastrous results from the point of view of killing microbes, e.g., carbolic acid and quinine; while others again, such as flavine and rivanol, are rendered ineffective *in vivo* by reason of their high affinity for the fixed tissue cells of the body generally. In one or other of these ways almost every drug which has been proposed as an "internal disinfectant" comes to grief. They fail in the crucial test, viz., in their power to confer upon the patient's blood the power to kill more microbes than it had before they were administered.

[1] It will perhaps be claimed that eusol was intended to neutralize toxins produced by the streptococcus, but I know of no evidence that it has any such effect. Indeed we know very little about streptococcal toxins.

Antistreptococcal serum is in a somewhat different category; although it has no appreciable power itself to kill streptococci, there was a possibility that it might neutralize toxins produced by that microbe and so enable the patient's blood to exert a greater bactericidal effect.

My colleague, Dr. Todd [11], has investigated this and finds that when the serum is added to normal or septicæmic blood it has only a small effect of this kind —no more indeed than normal horse serum. To obtain even this small effect in the patient one would have to inject about a pint of serum. The laboratory evidence at hand does not therefore support the use either of this serum or of any of the drugs mentioned.

There are two measures which appear to be more hopeful, although no big claims can be made for either of them yet. All that can be said is that they do definitely increase the power of the patient's blood to kill hæmolytic streptococci, often for many hours. The two measures I refer to are blood transfusion and the use of arsenical drugs of the neosalvarsan type.

I want, in conclusion, to say something about each of these. First, as to blood transfusion. Before discussing the results already obtained, let us consider one or two points which bear on them. When we do a transfusion of blood we are adding about a pint of a powerful bactericidal agent to about nine pints of the patient's blood, which is not only ineffective but frequently also full of microbes, and, presumably, some of their toxic products. In other words, dilution of the blood injected, and possibly also its very rapid deterioration by noxious influences, have always to be reckoned with as factors which stand in the way of a successful result. This being so, it is clearly of the utmost importance that the blood we give should be of the highest possible potency. For the past two years, following the lead of Sir Almroth Wright [12], we have sought to reinforce the antibacterial qualities of the donor's blood, either by adding a suitable dose of vaccine to it after withdrawal, or by inoculating the donor a few hours before taking his blood. The name immuno-transfusion has been applied to this procedure. Further, to the same end, when we found [13] that these were injurious to the donor's leucocytes, we abandoned the use of decalcifying agents, such as sodium citrate, in carrying out the transfusion, and adopted instead a technique for defibrinating the blood. This involved some loss of leucocytes, about 30 per cent., but those that remained were of full activity. The immuno-transfusions we have carried out on some twenty-five cases of puerperal fever in the past two years have all been done in this way, with defibrinated, immunized blood [14]. In a few cases it has been combined with treatment by arsenical drugs.

The results have been promising from the laboratory man's point of view; that is to say, we have on several occasions been able to show an improved killing power in the patient's blood following such transfusions, and sometimes a diminution in the number of streptococci in the circulation obtained by blood culture. From the clinician's standpoint, however, the results have been, on the whole, somewhat disappointing. Broadly speaking, they seem to show that the treatment has been of value in the less severe cases, but has had little effect in those with very heavy blood infections. That result is, I think, what might have been anticipated.

In the last few weeks we have been asking ourselves whether these results represent the best that can be hoped for—and whether the procedure we have adopted could be further improved upon? I think there is no doubt that it can—and very considerably. As I have already told you, the defibrinated blood we have been in the habit of using is blood brought (by vaccination) to a higher level of bactericidal efficiency than normal blood. But its efficiency is not usually raised a great deal above the normal level—it is difficult to express the difference in figures, but let us call it 10 to 20 per cent. We now find that a very much greater increase

of efficiency—perhaps 200 per cent.—is obtained if we double or treble the number of leucocytes in the blood. Clearly, then, this is what we should aim at in using blood for immuno-transfusion. To this end we propose in the immediate future to substitute whole blood for defibrinated blood (this in itself will give us some 30 per cent. more leucocytes), and also to induce artificially a leucocytosis in the donor by means of nuclein.[1] Let me show you the result of an experiment which illustrates very well what we hope to gain by this procedure. A donor was injected with $2\frac{1}{2}$ c.c. of nuclein intramuscularly. Samples of blood were taken from a vein before this injection and four hours later. The leucocyte count of these two samples of blood was respectively 5,500 and 20,000. The bactericidal efficiency of these two bloods was compared by infecting each with the same number of hæmolytic streptococci (3,600 cocci per 50 c.mm. of blood), and keeping them slowly moving in the incubator for two hours. At the end of that time the bactericidal action of the blood was stopped by mixing the blood with a large volume of melted agar. The subsequent growth of colonies in this agar informed us how many streptococci had survived the action of the blood. This was as follows:—

In the blood (50 c.mm. sample) taken before the injection of nuclein, 1,050 colonies.
" " " four hours after " " 8 "

One can hardly resist the conclusion that blood of the quality of this second sample was very much more likely to help the patient than blood taken before the injection of nuclein, even when this was enriched some 10 or 20 per cent. by vaccination. It should here be remarked that the improvement in killing power shown by this experiment was probably not solely due to the leucocytosis, but in part to an increased opsonic power which Ledingham and Bulloch [15] and also Bedson [16] have demonstrated to be usually associated with it—in rabbits at any rate.

Secondly, as to the arsenical drugs. The work done in connexion with these is now being prepared for publication in full, and I shall therefore discuss the matter only very briefly. The reason why neosalvarsan, and the compounds closely related to it, seem to offer more hope of success in the treatment of puerperal septicæmia than the drugs previously mentioned is just this—that after the administration of the neosalvarsan the blood-serum of the patient has, and retains usually for twenty-four hours, a largely increased power to kill hæmolytic streptococci.

Curiously enough, the drug exhibits some degree of specificity for these particular streptococci, other types being but little affected by it. If this were the whole story we might almost *expect* success, but other factors have to be considered which introduce a certain amount of doubt. We have to remember that the drug is being excreted all the time and that the concentration in the blood is therefore falling; and, in association with this, the fact that the bactericidal action of the drug is strangely slow, not coming into play at all for three or four hours; further, the possibility (there is a little evidence pointing to this) that successive generations of streptococci may become to some extent tolerant of the drug, even within a day or two; and, finally, the fact that the patient's leucocytes, like the microbes, are to some small extent susceptible to the slow action of the drug—though the evidence suggests that in the body this counts for little.

The position, then, is this: we have a drug which, on the laboratory findings, might well be capable of directly killing off a large number of streptococci in the body, but we cannot feel *confident* that it will achieve this. The event must be decided by clinical trial on septicæmic patients—and this trial should be supplemented, whenever possible, by laboratory investigations informing us as to the

[1] The use of whole blood has another possible advantage, viz., that we give the patient also platelets, which are not present in any number in defibrinated blood. There is a certain amount of evidence that these platelets play a part in clearing the blood of microbes in septicæmia. Further work on this aspect of the problem is required.

diminution or otherwise of the streptococci in the patient's blood following a dose, the effect upon the functioning of her leucocytes, &c.

The clinical results available up to the present are too few to warrant any definite statement. They are certainly not so good as to suggest that we have in neosalvarsan an easy and sure cure for septicæmia—nor are they without some elements of hope. As to practical suggestions, I shall say only this: that it would seem best to use doses of moderate size, e.g., 0·6 gr. of novarsenobillon (I have used this preparation for the most part), or in a very heavily infected case 0·9 gr., intravenously, of course. And in grave cases I think it would be expedient to follow up the dose—in twelve hours or so—with an immuno-transfusion in order to counteract any injurious effect that the drug might have had upon the patient's leucocytes. Experience has suggested—though the point is not settled—that it is best not to repeat the dose.

Finally, let me say this with regard to the problem of treatment. If these two measures prove not to be immediately and strikingly successful, but if it is agreed that their basis is sound, the proper course is not to abandon them, but to concentrate our efforts on finding out wherein they fail and how they may be improved upon. Ehrlich did not produce salvarsan on a few weeks' work, nor was any important success in the treatment of trypanosomiasis achieved until many years of patient laboratory work had been spent upon the arsenical preparations.

May I, in conclusion, take this opportunity of suggesting the urgent need of better organization in order to hasten progress. Progress, it seems to me, is held up more by this circumstance than by anything else, that the cases are scattered between fever hospitals, Poor Law infirmaries, maternity hospitals, nursing homes and general hospitals, no one medical man having charge of more than a few cases each year. This means that little or no opportunity is afforded for the laboratory investigation of most of the cases, and nothing is learned from them. Each doctor has to make up his mind from his very small experience which of many ineffective remedies is the least ineffective.

We want, first of all, concentration of the cases in all big cities into one, or at most two centres, where serious work may be done in connexion with them.

Manchester, as we have heard to-night, has taken the lead in this matter. It collects all the cases, among the poorer classes at any rate, into one hospital, and has appointed a whole-time medical officer to look after them, giving him also facilities for carrying out the necessary laboratory investigations.

Such an amalgamation of the clinical ward and the laboratory into one unit seems to me an admirable arrangement for dealing with a problem of this kind, involving only a comparatively small number of cases. In London a step has recently been taken in the same direction, the Metropolitan Asylums Board having arranged to concentrate its cases into three of the fever hospitals. I should like to see the concentration carried still further and much more provision made for investigation and research.

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Discussion.—Dr. LOUISE MCILROY said she had recently had considerable experience of the glycerine drain and that the results were most encouraging. In some cases it was advisable to retain the rubber drain for some hours, if the uterus did not expel it. This method of treatment commended itself more especially in cases of septic abortion. She found that much advantage resulted from the use of antistreptococcic serum in cases of sepsis, and used it as a routine in cases in which there was blood infection. Transfusion of blood gave good results, but these were only transitory. The patient did well for a few days, and then relapsed, unless the transfusion was repeated. The open-air treatment of puerperal sepsis with uterine drainage gave the most satisfactory results of all methods.

Dr. A. D. MORRIS remarked that he too had seen, with considerable astonishment, pus pouring out from the uterus after the insertion of a soft rubber catheter. In one case he had drawn off an ounce and a half of pus. These cases were all recent infections having a rise of temperature on the third day after delivery, and not cases of about two weeks' standing. Lymph drainage, after Dr. Hobbs' method, was immediately performed, as soon as a rise of temperature occurred, and the pus drawn off as early as the third day of the puerperium.

Dr. PHILLIPS and Dr. COLEBROOK replied.

Section of Obstetrics and Gynæcology.

President—Mr. T. G. Stevens, F.R.C.S.

Carneous Mole Retained Fifteen Months *in Utero*.

By T. G. Stevens, F.R.C.S. (President).

G. W., aged 23. One child in 1922, had her last natural period on August 16, 1923. December 22, 1923, a sharp attack of pain occurred but there was no hæmorrhage. At the end of January, 1924, she was seen by Dr. Walker, of Waltham Cross, who diagnosed pregnancy of four months' duration. On February 28, Dr. Walker saw her again and considered that the pregnancy was normal, and arranged to attend the confinement about June 23. At that time the height of the uterus was at the umbilicus. Soon after this a slight attack of pain and hæmorrhage occurred. On April 9 she was again examined because she said she was not increasing in size. The uterus was then smaller and its upper level reached halfway between the pubes and the umbilicus. No movements were felt. A mole was then diagnosed and ergot in full doses was given, but apart from a small amount of pain nothing happened. She was seen again on May 31, and the uterus was found to be a little smaller and the patient felt perfectly well. She was advised to come to St. Mary's Hospital, but did not do so until August 13, exactly one year since the last natural period. Except for the slight hæmorrhage in February there had been absolute amenorrhœa during the whole of this time. On August 13 she was seen by me: the uterus then was enlarged and reached half-way between the umbilicus and pubes; it was very hard and the upper part felt spherical in shape as if it contained a fibroid. The cervix was long, hard and rigid. She felt perfectly well and did not wish to have anything done. I saw her again in October, when the uterus was found to be in exactly the same condition. There had not been any hæmorrhage in the meantime. Finally, she was admitted to St. Mary's Hospital on November 11 in exactly the same condition. The uterus was so hard and its fundus so spherical in shape that it was thought that there must be a fibroid present, in spite of the amenorrhœa. The possibility of a retained carneous mole was not lost sight of, but the absence of hæmorrhage, and the shape and consistence of the uterus, seemed to negative it. Accordingly I did an exploratory operation, and even then the uterus looked as if it contained a single fibroid. A vertical incision was made in the anterior surface of the uterus, and it was then seen that the enlargement was due to a retained carneous mole. This had no attachments to the uterine wall and was removed entire, the uterus being sutured as in a Cæsarean section. The patient made an uninterrupted recovery.

The mole was a very large one and was solid; the amniotic cavity, being squeezed quite flat, was very difficult to recognize. On section it showed chorionic villi, decidua and blood-clot. The villi showed some degenerative changes, chiefly in the form of accumulation of fluid in the connective tissue core.

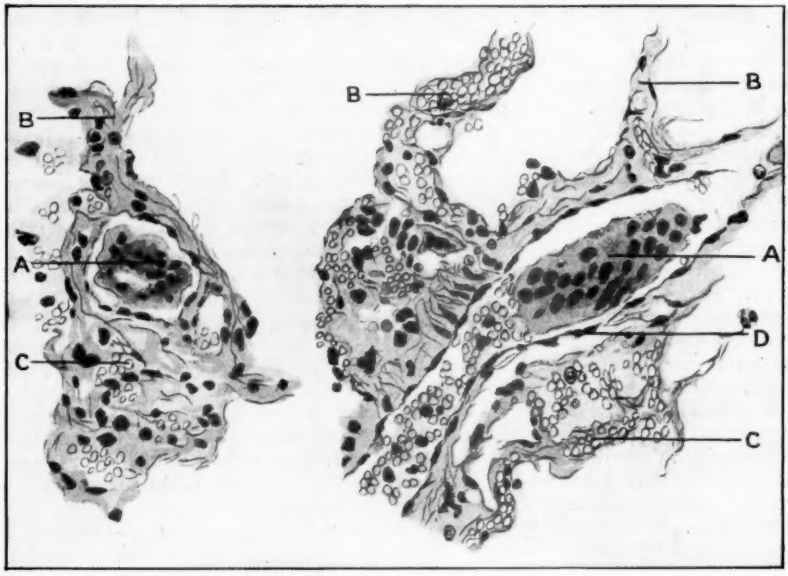
There seems to be no doubt that this was a true case of retention of a mole for fifteen months, as the case was watched the whole time, and at no period was anything passed except a trifling amount of blood on two occasions.

Hydatidiform Mole: Expulsion, and Death from Pulmonary Hæmorrhage.

By T. G. Stevens, F.R.C.S. (President).

H. S., aged 32, was admitted to St. Mary's Hospital, July 17, 1924, complaining of intermittent blood loss for three months. The last normal period occurred in March, and the April period was missed. The uterus was too large for a normal pregnancy of four months, and the diagnosis of a hydatidiform mole was made tentatively.

On July 18 the cervix was dilated, and the diagnosis was confirmed by pulling out a piece of the mole with forceps. A small Horrocks bag was then introduced to try to make the uterus expel the mole. On July 22, nothing having happened, pituitary extract was given in 3 ♏ doses every two hours. Uterine contractions occurred, and at 9.45 p.m. the mole was expelled. About half a pint of blood was lost during



Sections of lung showing emboli of trophoblast. A.—Trophoblast. B.—Wall of alveolus with capillaries. C.—Blood. D.—Vessel wall containing the embolus. Camera lucida drawing: ⅛ objective.

the expulsion, but the patient's condition became very bad, the pulse rising to 180 and becoming very feeble. Intravenous gum-saline solution was given, and at 11 p.m. there was considerable improvement. At 11.45 p.m. the patient coughed up bright red frothy blood and died immediately from asphyxia.

At the post-mortem examination the lungs showed general œdema, and almost universal hæmorrhage into the alveoli and smaller bronchi. The cause of this hæmorrhage was at first obscure, as there appeared to be no disease of the lungs, such as tubercle, broncho-pneumonia, or lobar pneumonia. Sections made from different parts of the lungs, however, revealed the cause of the hæmorrhage. It was

the result of invasion and destruction of the capillaries in the alveolar walls by fragments of deported villi. These seemed to be universally distributed, as sections from several parts were taken and all showed the same lesions. Deportation of villi has long been known to us, but this is the first occasion on which the writer has known of any serious results from it apart from the secondary deposits of chorion epithelioma. Although the uterus in this case shows some invasion of its wall by trophoblastic proliferations, there is nothing to be found which at all suggested a chorion epithelioma.

Normally, it must be concluded that deported villi are dead structures and disappear by liquefaction or absorption. In this case they evidently retained their vitality, and exercised their normal function of attacking and opening up blood capillaries, with disastrous results to the patient.

Hydatidiform Mole Removed by Hysterotomy.

By T. G. STEVENS, F.R.C.S. (President).

MRS. H., aged 30. Seen in consultation with Dr. Walker, of Kensal Rise, in July 1925. The patient had missed one period, and had then complained of intermittent hæmorrhage, with a little pain for several weeks. The uterus, on examination, was found to reach the umbilicus, and was larger than it should have been, assuming that pregnancy had occurred. Its consistence was abnormal, being hard in parts, doughy in others. No fluctuation could be felt or fluid thrill; no fœtal parts were felt. A provisional diagnosis of hydatidiform mole was made; this was confirmed by dilating the cervix, and by the removal of a fragment of mole with forceps. A small Horrocks bag was introduced with the object of endeavouring to make the uterus expel the mole. The cervix was very hard and unyielding, and in spite of the bag being left in four days, weights being upon it, and small doses of pituitary extract being given intramuscularly, nothing happened. As the patient was very nervous, the cervix very unyielding, and a slight rise of temperature had occurred, it was determined to open the abdomen and remove the mole by incising the uterus.

This was done, and it proved a very simple procedure, the mole being completely and cleanly removed by turning the uterus partly inside out. The uterine incision was sutured as in a Cæsarean section. The patient made an uninterrupted recovery. The succeeding periods were somewhat irregular and abnormal, but now, six months afterwards, she is quite well. I bring this case forward in support of the plea that in certain instances in which the uterus is sluggish and does not respond to stimulation, hysterotomy is the operation of election for hydatidiform mole.

Discussion.—Dr. J. S. FAIRBAIRN said that as the President asked for similar experiences of long retention of a carneous mole, he could remember having met with a case in which there was nearly as prolonged retention and the mole was ultimately removed by operation, but unfortunately so long ago that his recollection of the clinical details was not clear. The patient was a young married woman—under twenty-five—with a history of amenorrhœa of somewhere about fifteen months, and a hard, enlarged uterus that closely simulated one containing a fibroid. The age of the patient and the total absence of menstruation shortly after marriage in one previously regular did not, however, suggest fibromyoma in this case. Three months' trial of various fulminant preparations of ergot proving ineffective in exciting uterine action, and the woman being anxious to get to her childbearing, she was taken into hospital, the cervix dilated and a hard mass of old blood-clot removed in pieces with some trouble, but almost without any fresh bleeding.

The sections from the second specimen clearly showed the cause of death; they were remarkable and unusual.

He was in complete agreement with the principle stated by the President, that in the management of a vesicular mole our object should be rather to encourage the uterus to empty itself than to remove the mole digitally or otherwise. Cases, however, occurred in which artificial removal was required because of delayed or incomplete expulsion with hæmorrhage. He had not found the difficulty so great as the President made out, either in dilating the cervix or in reaching the contained material. He would agree that in all, or nearly all, the

cases in question, the mole had probably been partially expelled, but by clearing out the lower portions within reach by the finger, and those higher up with ovum forceps, and by squeezing down the uterus from the abdomen, he had found it possible ultimately to explore the whole cavity with the finger. The cases were afterwards watched carefully, and in one in which bleeding recurred the uterus was again explored and an attempt made to remove attached fragments with the curette. The material removed was reported by Professor Dudgeon to contain masses of blood fibrin, fragments of muscular wall of uterus, and degenerate villi, without any evidence of cellular proliferation. Nothing further was done and the patient remained well.

He could only admire the President's perspicuity in knowing beforehand that the cervix was undilatable and his courage in performing abdominal hysterotomy after all that had occurred. But he (Dr. Fairbairn) considered that Mr. Stevens was treading on dangerous ground in advocating hysterotomy. He confessed himself to having done it once, not of malice aforethought but on account of an erroneous diagnosis. As in the instance of the first specimen shown, he had removed a mass of clot and cystic mole from an enlarged uterus instead of enucleating a degenerate fibroid, as he had expected.

Mr. ARTHUR CROOK said that in response to the President's request for the experience of other members of the Section, he had had about eight cases of cystic mole, all of which had been spontaneously expelled. He (the speaker) had made it his practice to explore the cavity of the uterus under a general anæsthetic, going to the fundus if possible with the finger only, to remove any débris that might be there. Also, after the exploration, at an interval of at most a month, he did a formal curettage, irrespective of the presence or absence of symptoms.

A Case of Obstructed Labour due to Conjoined Twins.

By G. F. GIBBERD, M.B. (introduced by EARDLEY HOLLAND, F.R.C.S.).

THE mother was aged 28, and her one previous pregnancy had resulted in the birth of living twins at full term.

Her second pregnancy had been normal, so far as she knew, and labour came on at full term. Her own medical attendant was looking after her at the time, and he thought it a case of straightforward labour with a vertex presentation. After she had been in labour about six hours, the cervix was fully dilated with the head well down in the pelvic cavity, but as no advance had been made for some time, her doctor applied the forceps and delivered the head and shoulders fairly easily, but was quite unable to deliver the rest of the body.

She was then admitted to the City of London Maternity Hospital under the care of Mr. Eardley Holland. On admission, the head and shoulders of a fœtus were protruding from the vulva; there was some laceration of the anterior vaginal wall, and a perineal tear extended nearly to the anal margin. Abdominal palpation revealed a fairly retracted, and apparently empty, upper uterine segment, with a very dilated lower segment, which contained a mass lying transversely; this mass was of sufficient size, and of such a shape, as to suggest that it was a second fœtus, although no fœtal parts could be made out definitely. The uterus was contracting forcibly and frequently, the intervals between the pains being less than a minute. The patient's general condition was fairly good.

This case, therefore, at the time of admission to hospital, seemed to be one of locked twins, but it was difficult to conceive how they could be locked after the head and shoulders of the first had been born. Assuming that the mass lying transversely above the brim was a second fœtus, the only explanation of the condition that seemed at all probable was that the fœtuses were joined together.

Morphia ($\frac{1}{4}$ gr.) and a general anæsthetic were given. On the hand being passed along the ventral aspect of the half-delivered fœtus, its chest was found to become continuous with the chest of a second fœtus which was lying transversely above the brim, with its head in the left iliac fossa. By passing the hand along the dorsal aspect of the first fœtus, its buttocks were identified as lying in front of the body of the transverse fœtus and rather towards the right iliac fossa.

The area of junction between the twins was then cut through with a long pair of scissors guided by the fingers—this involved, amongst other things, the cutting of several costal cartilages. When completely separated the first fœtus was delivered easily by gentle traction on the shoulders. This left the second fœtus lying transversely above the brim of the pelvis. A foot was then seized and brought down, and the second fœtus was delivered as a breech. The perineum was sutured and a catheter tied into the bladder.

The first fœtus weighed 6½ lb.; the second 7½ lb. The sex was male, and both were well formed.

They were joined to one another in the mid-line by their lower costal margins and by the upper two-thirds of their anterior abdominal walls. There was one

umbilicus, situated just below the line of junction on the larger fœtus, and into it was inserted the umbilical cord which contained four arteries and one vein. The arteries were traced back to their origins, which were normal (i.e., one artery from each internal iliac artery in each fœtus). The umbilical vein could not be traced because the tissues in this region were so extensively lacerated at the point at which the two fœtuses had been separated. There was a common liver lying beneath a diaphragm which was continuous across the mid-line between the two fœtuses. Apart from this, each fœtus had a completely separate set of viscera. There was one amnion and one chorion. The placenta weighed 2 lb. 2 oz.

As the patient was not admitted to hospital until after the head and shoulders of

the first fœtus had been born, the mechanism of the first part of labour can only be surmised.

Before labour, the twins must have been lying face to face in the longitudinal axis of the uterus, with the two heads forming the lower pole, i.e., in the same relative positions as they are now shown (they have been reconstructed by sewing together the cut skin edges).

When labour started the head of the smaller fœtus engaged and was forced down into the pelvic cavity, while the head of the larger fœtus was pushed over into the left iliac fossa—this entailed a rotation of the second fœtus about an axis at right angles to the plane of junction with its brother. As the head of the first fœtus descended further, this rotation increased until it reached its maximum of about 90° by the time the head and shoulders of the first were born. The second fœtus was thus forced to assume a transverse lie, in the dorso-posterior position, with the head in the left iliac fossa.

The prospects of spontaneous delivery, therefore, depended upon the behaviour of the transverse fœtus. Spontaneous version or rectification was obviously impossible because the middle part of the trunk was firmly fixed over the pelvic inlet by its attachment to the first fœtus. Spontaneous evolution or expulsion was, therefore, the only possible method by which such a condition could have righted itself, and this could have taken place only had the second fœtus been very small. As it was, the second fœtus weighed 7½ lb., so that natural delivery was quite out of the question.

De Lee states that no case of double monster has ever been diagnosed before labour, but he draws attention to certain points which may help in the diagnosis of the condition after labour has started. He points out that the diagnosis of twin pregnancy is usually made, but suggests that if some congenital abnormality is found upon the part of the first fœtus that has been born (such as spina bifida, hare-lip or cleft-palate), then the possibility of the twins being joined should be thought of, because double monsters frequently show such abnormalities. If two bags of waters can be made out, the presence of a double monster can be definitely excluded.

R. Birnbaum, quoting Veit, states that if the first fœtus in a twin pregnancy is found lying transversely, the presence of a double monster should be suspected; since such a lie in ordinary twin pregnancy is extremely rare.

In Blacker's translation of R. Birnbaum's work on "Malformations of the Fœtus" detailed consideration is given to the mechanisms and available methods of delivery in these cases. An analysis of 119 cases collected by Holl is given, in which spontaneous delivery occurred in 62 per cent.; delivery by manipulation (such as version, traction, &c.) in 23 per cent.; and delivery after destructive operations in 15 per cent. The conclusions, drawn partly from those figures and partly from general considerations, are that, in the first place, spontaneous delivery is a very likely method of termination of labour; and, secondly, that in cases in which interference is necessary, destructive operations are not usually called for. In cases of thoracopagus which have reached the stage at which the head of the first fœtus is delivered and the second fœtus is lying transversely above the brim of the pelvis, it is recommended that the feet of the first or second (or the feet of both) should be seized and delivery of the two trunks together attempted. To render this possible the bond of union between the twins must be sufficiently plastic to allow of rotation through 180°—and also the bodies of the twins must be small enough to allow of their both being in the pelvis at the same time. If the monster is too big to allow of this manipulation, evisceration of the first is recommended in preference to intra-uterine section of the twins. The latter method is mentioned, but its use is not advised owing to the danger of injury to the mother.

One case is quoted in which the feet of the second fœtus were seized, but owing to the size of the trunks it was not possible to get both bodies into the pelvis at the same time. The head of the first was removed, the thorax was eviscerated, and part

of the thoracic wall taken away. After this had been done it was found comparatively easy to pull the body of the second fœtus into the pelvic cavity in company with the remains of the first. The difficulty in this case was ascribed to the size of the monster; it weighed 8¾ lb. without the contents of one thoracic cavity. There are no other figures stated as to the weights of the monsters in the cases quoted, but this case is considered unusually large. De Lee states that cases weighing 15 to 17½ lb. are on record, but no other details are given.

It seems therefore that the case here reported was one in which the twins were of very unusual size, and the general considerations laid down by Birnbaum do not apply. (The weight of the first fœtus was 6½ lb., and that of the second, 7½ lb., i.e. 14 lb. in all.) There was no possibility of bringing both trunks into the pelvic cavity at once, so that the treatment resolved itself into either intra-uterine section of the twins, or evisceration of the first followed by version of the second. Although the second procedure is the one favoured in the account quoted above, and indeed intra-uterine section is stated to be inadvisable, yet in the case here reported, the operation of section was done as being the most suitable in the circumstances. As a matter of fact the technical difficulty was not great, in spite of the facts that the vagina was occupied by the body of a 6½ lb. fœtus, that the section was made above the level of the pelvic brim, and that it involved cutting through the lower costal margin.

I am indebted to Mr. Eardley Holland for permission to read these notes and for allowing me to show the specimen.

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[*January* 7, 1926.

Krukenberg Tumours of the Ovaries.

By Wilfred Shaw, F.R.C.S.

In 1896 Friedrich Krukenberg [1] gave a masterly description of a type of ovarian neoplasm which up to that time had not been recorded. His material was derived from five cases; two of the patients came to autopsy and accurate post-mortem examinations were made upon them.

Krukenberg pointed out that the tumours occurred in young women as well as in the aged, were of slow growth and were usually accompanied by ascites. The tumours were bilateral, retained the general shape of the normal ovaries and had smooth surfaces (fig. 1). They were mainly of a uniform solid consistency, though in some cases areas of degeneration with cystic-like spaces were seen and in other cases white opaque areas were present. The tumours were about 12 by 10 by 6 cm. in diameter. The interest of the tumours lay mainly in their microscopical characters. The histological form was as follows: the stroma consisted of fibrillæ in the form of spindles with oval nuclei, densely packed together, having an irregular arrangement amongst themselves, and producing the form of a fibrosarcoma. But, in addition, another type of cell predominated, and it was this cell which was responsible for the interest of the tumour. The cell was large, about ·008 mm. in diameter, round or oval in shape with bright translucent homogeneous protoplasm, with its nuclei pushed to one pole of the cell and flattened out against the cell membrane at that spot. Consequently, the appearance of the cell closely resembled that of a signet ring (figs. 2 and 3) and Krukenberg pointed out that the picture of these signet-ring cells in a sarcomatous stroma was the main character of the histological structure of these tumours. He also showed that the cells contained mucin and that sometimes they were collected in nests or in rows and that rarely a suggestion of an alveolar arrange-

ment could be made out. Further, they were sometimes seen surrounded by endothelial cells and apparently lying in the lumina of lymphatic channels. In view of the histological structure Krukenberg concluded that the tumour was a fibrosarcoma and he considered the signet-ring cells to be derived from the stroma cells, but because of their mucus content and because of their similarity to carcinoma cells, at the suggestion of Marchand he termed the tumour a fibrosarcoma mucocellulare carcinomatodes. Partly because of this cumbersome terminology and partly because of Krukenberg's classical description of these tumours the term Krukenberg tumour is now universally given to this type of growth.

Krukenberg considered that the tumours were primarily ovarian in origin, but it was later pointed out by Wagner [2], Schlagenhaufer [3], Kraus [4], and others, that Krukenberg's tumours were usually found in association with carcinoma of the stomach. The result was that Krukenberg's view of their nature and origin was strongly opposed. Although at the present time there is a fairly extensive literature on this subject, there are certain features of these tumours which still require elucidation and it was to bring these points forward that this paper was written.

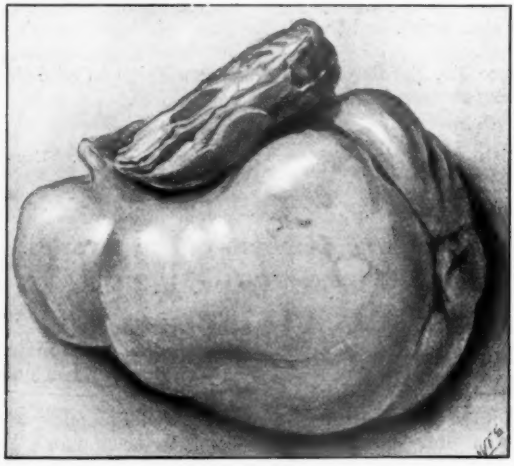

FIG. 1.—Krukenberg tumour: illustrating the shape of the tumour and the smooth surface.

Case I.—Admitted to St. Bartholomew's Hospital under care of the late Dr. Herbert Williamson, March 17, 1924.

Housewife, aged 44, married twenty-six years. Catamenia began at 14, cycle $\frac{6\text{-}7}{28}$ days. Pregnancies, 13; 11 children; 2 miscarriages. Last child born in December, 1923; premature birth. Since August, 1923, pain in epigastrium and back, accompanied by vomiting. This persisted until the premature birth in December, 1923. After her delivery patient noticed a lump in the lower part of her abdomen. In January, 1924, a normal period; since then amenorrhœa.

On Examination.—Heart and lungs normal. A tumour, felt arising out of the pelvis about 5 in. by 4 in.; oval in shape; smooth surface; movable; solid consistency; no enlargement of the liver; no œdema of legs; urine normal.

Bimanually.—The tumour felt on abdominal examination lies to the left of the uterus, is solid and movable; in the pouch of Douglas is another swelling, feeling like a prolapsed enlarged ovary.

Diagnosis.—Bilateral malignant ovarian tumour.

Operation, March 20, 1924.—Dr. Herbert Williamson. Ascites; both ovaries replaced by solid tumours. Bilateral ovariotomy and appendicectomy. Tumour left side, 7 in. by 3 in. by 2 in.; solid; smooth surface, a little cystic degeneration in middle with white opaque areas scattered through the tumour. Right side, 3 in. by 2 in. by 2 in., similar to that of left side. Both tumours were ovoid and in each case the broad ligament was infiltrated with growth.

Microscopically.—The tumours were found to have the characteristics of Krukenberg tumours.

After the operation the patient gradually sank and died, April 6, 1924.

FIG. 2.—Low power: The signet ring-cells are shown in a fibrosarcomatous stroma. They are shown collected together in bunches. × 50.

Autopsy, April 7, 1924.—A large carcinomatous ulcer was found on the lesser curvature of the stomach, 1½ in. by 2 in. in diameter. There was no erosion into the peritoneal cavity. The glands along the lesser curvature, those around the pylorus, the retrogastric, the superior lumbar, the aortic and mesenteric glands, were all invaded by carcinoma. No metastases on peritoneum. Liver clear of metastases. No intrathoracic metastases present.

Case II.—For the records of this case I have to thank Mr. Harold Griffith, of Torquay.

♀ Aged 38. Admitted to Torbay Hospital May 11, 1925. Catamenia cycle 7/8 days. One pregnancy in 1920, normal. Last period May, 1924. Patient complained of pain in stomach

and in back, and of a lump in the stomach. Abdominal pain dated from May, 1924. Bowels regular, but an indefinite history of blood and mucus in the stools. No history of nausea or of vomiting.

On Examination.—Very anæmic; breasts normal; heart and lungs normal. Abdomen: rising out of pelvis is a hard, solid, nodular tumour extending up into the iliac fossa 6 in. above symphysis pubis, freely movable, not tender. Signs of free fluid in abdomen.

Bimanually.—In front of uterus and apparently separate from it is a hard swelling continuous with the abdominal tumour. To the left is another small, hard, freely movable tumour.

Diagnosis.—Double ovarian tumour.

FIG. 3.—High power: Illustrating the characters of the signet ring-cells. × 250.

Operation.—May 20, 1925. Large tumour replaced the right ovary; the smaller one resembled an enlarged left ovary. Both tumours removed. No exploration carried out because of the patient's poor condition. Both tumours were smooth, white, hard and heavy. There was an area of degeneration in the large tumour, and a few small cysts were present on the surface. Microscopically, the tumour had the form of a typical Krukenberg tumour.

After the operation an irregular mass could be palpated below the right costal margin, and the patient once vomited a little altered blood. The patient's general condition gradually became worse and she died three weeks after operation.

Case III.—For the records of this case I have to thank Sir Charles Gordon-Watson.

Aged 27. One pregnancy five years ago.

December, 1921.—For two years history of dyspepsia and vomiting after food. Fourteen days ago severe hæmatemesis.

X-rays.—Gastroptosis and gastric ulcer.

December 21, 1921.—Posterior gastro-jejunostomy; gastric ulcer in lesser curvature near pylorus. Uninterrupted recovery; gastric symptoms cleared up and patient remained well until three years later (January, 1924), when she noted that her feet were beginning to swell and that her abdomen was getting bigger.

January 31, 1924.—Extensive ascites, and, on bimanual examination, a large ovarian tumour found.

February 5, 1924.—Laparotomy; several pints of ascitic fluid evacuated and two solid ovarian tumours, lying free, removed. Stomach was examined and found surrounded by adhesions and much induration. No nodules were found on peritoneum and no retroperitoneal glands were recorded as present. The patient died three months later with a blood-stained pleural effusion.

Microscopically, the tumours had the form of Krukenberg tumours.

Cases IV and V.—Specimens from the museum of St. Bartholomew's Hospital. I have to thank the curator, Dr. T. H. G. Shore, for the records of these cases.

Case IV.—Bilateral ovarian tumours removed from a married woman aged 51, a multipara, in 1894. For three years menstruation had been irregular and excessive. The abdomen had been swollen for two years, and vomiting had been troublesome for six months. Laparotomy was performed and revealed double ovarian tumours, each the size of a fœtal head. There was free fluid in the peritoneum and the omental fat felt very hard. She recovered from the operation, but the vomiting was not relieved, and a hard mass was palpated in the epigastrium. Death occurred from pneumonia one month after the operation.

Post mortem, the pyloric third of the stomach was found to be thickened and indurated, and showed on its mucous surface a small ulcer. Microscopic examination of the stomach showed chronic inflammation, but no conclusive evidence of malignant disease. The section of the stomach wall has not been kept. The tumours have the appearance of Krukenberg tumours, and microscopically their structure is typical.

Case V.—Bilateral ovarian tumours solid in consistency and much lobulated on the surface. Removed at operation, 1908, from a woman aged 44. She had borne one child at the age of 25, and had never since been pregnant. Menstruation had been normal, though scanty. The tumours were removed within a few weeks of the detection of the abdominal enlargement. Recovery was uneventful, and three months later there was no evidence of recurrence. No further history is available.

The first point to consider is whether these tumours are primarily ovarian in origin, as Krukenberg considered them to be, or whether they occur as metastases of some growth arising primarily in a distant organ.

It was not until about twenty years ago that the frequency with which malignant growths of the ovary were secondary to growths elsewhere in the body was recognized, and a review of the literature shows that before the publication of Krukenberg's paper cases had been described in which sarcomata of the ovaries had been found in association with carcinoma elsewhere, and that these cases had been considered as affording interesting examples of Pfannenstiel's theory of the multicentric origin of malignant growths. For example, von Fleischmann [5] had described a case of carcinoma of the pylorus associated with fibrosarcomata of the ovaries; Temesvary [6] had collected 300 cases of ovarian sarcomata in which four carcinomata had been found in other situations; Rubeska [7] had described six cases of carcinoma of the stomach or gall-bladder in which the ovaries had been involved five times with carcinoma and once with sarcoma; and Bode [8] had recorded two cases of carcinoma of the pylorus in which a fibrosarcoma and an endothelioma had been found in the ovaries. After the publication of Krukenberg's paper Kraus, in 1901, recorded cases of Krukenberg tumours associated with carcinoma of the stomach and of the cæcum; Schlagenhaufer, in 1902, recorded two cases of carcinoma of the stomach in which Krukenberg tumours of the ovaries were found; and Wagner, in 1902, described a case in which a scirrhous carcinoma of the stomach and Krukenberg

tumours of the ovaries occurred simultaneously. It was after the publication of these papers that doubts were raised as to the ovarian origin of the Krukenberg tumour. Of Krukenberg's original cases two came to post-mortem, one died subsequently with gastric symptoms, and in two no details of the patients' histories were given. In Krukenberg's first case, which was described very exactly, the stomach was recorded as being invaded by growth but no ulcer was present. It seems clear, from Krukenberg's paper, that he was not altogether satisfied with the hypothesis of the connective-tissue origin of the signet-ring cells, for he discusses in detail the question of their origin, and in turn excludes the follicular epithelium, Pflüger's cords and para-ovarian remains as being responsible for their origin.

A review of the literature shows that up to the present time about sixty cases have been recorded, and it can be stated definitely that, with the exception of the few cases mentioned below, in all cases where a complete examination has been made, either at operation or at autopsy, a carcinoma has been found elsewhere. It is insufficient to exclude a primary growth elsewhere purely on clinical grounds, for it is the characteristic of this growth that it arises in young women. Further, as Bland-Sutton [9] and Amann [10] have pointed out, ovarian metastases may far outstrip the primary growth both in size and in rate of growth, so that although in many of the cases recorded the primary growth has been small and insignificant in its influence, yet the metastases have been the dominant feature of the case. It follows that although no carcinoma of the stomach may be felt through the sub-umbilical incision made to remove the ovarian growths, it is wrong to state dogmatically that no carcinoma is present, and that a careful post-mortem examination is required to exclude a primary growth elsewhere. Cases of this type in which a post-mortem examination has been made (e.g., Kraus [4], Schlagenhaufer [3], Wagner [2], Stauder [11], Glockner [12], Amann [13], Jacobson [14], Hall [15]), show that a primary growth has existed elsewhere. On the other hand, the cases of Orthmann [16], Fischer [17], Outerbridge [18], are incomplete, for no post-mortem examination was made.

The problem, however, is not so simple as these points might lead one to believe, for cases of Krukenberg tumour have been described in which no primary carcinoma could be discovered post mortem. For example, Sternberg [19] described a case where there were multiple metastases of a growth which, histologically, resembled a Krukenberg tumour in the bone marrow and in which the ovaries were atrophied and the stomach was normal. O. Frankl [20] describes a case in which three years after the removal of a Krukenberg tumour the patient was well and no abnormality was found after X-ray examination of the stomach. Cohn [21] records a case of Krukenberg tumour of the ovary which came to post-mortem and in which the stomach was normal and no primary growth was found. Lastly, there is Schenk's [22] case, in which a Krukenberg tumour was removed at operation when the stomach appeared normal. A further operation was performed; the pancreas appeared indurated and a diagnosis of carcinoma was made. A post-mortem examination was made subsequently, and no carcinoma was found, the induration around the head of the pancreas being due to glandular metastases.

It follows that although most cases of Krukenberg tumour are undoubtedly associated with carcinoma elsewhere, the possibility of a primary Krukenberg tumour of the ovary arising cannot be excluded.

So much for the clinical side and the aspect of morbid anatomy. Histologically, there is good reason to believe that the tumour is metastatic. The signet-ring cells, with their mucin content, are surely more likely to be epithelial in origin, with their shape altered by the pressure of the surrounding stroma. The attempt at alveolar arrangement is again in agreement with this view. And as Krukenberg pointed out, it is extremely difficult to account for a primary alveolar carcinoma of the ovary. Further, it was shown by Müller [23] that metastases in the ovaries

frequently deviate from the structure of the primary form. Lastly, the tumour is always bilateral, and on general principles this is most easily explained by assuming metastases in symmetrical organs from a distant primary growth. Now, although, according to Pfannenstiel, 90 per cent. of all ovarian carcinoma are bilateral, it has been shown by O. Frankl [20] that metastatic carcinoma of the ovary is much more frequently bilateral than primary carcinoma of any type.

A study of the literature reveals that almost invariably Krukenberg tumours appear in association with carcinoma of the stomach. Isolated cases (cf. those of Kraus [4], Cohn [21]) have been described in which Krukenberg tumours have been found in association with carcinoma of the sigmoid or of the cæcum, but this list of cases is small. I have had the opportunity of seeing two cases of ovarian metastases from primary carcinomata of the sigmoid, and although the large columnar cells lose their rectangular form they still assume a well-marked alveolar arrangement and the sarcoma-like stroma is absent. Neither of these cases could be termed a Krukenberg tumour, although there was a certain resemblance in each case. The study of the nature of Krukenberg tumours therefore leads one to the conclusion that they are almost invariably metastatic and usually arise from carcinoma of the stomach.

The next point to consider is the route by which the cancer cells reach the ovaries. Direct spread is unlikely to occur in cases of carcinoma of the stomach, and dissemination by the blood-stream would lead to multiple metastases in distant organs in addition to the ovaries, and it is unlikely that the ovaries alone would be picked out if dissemination occurred in this way. The third possible method is implantation. It is well known that in many cases of carcinoma of the stomach multiple implantations are found on the peritoneum, and it is undoubtedly true that ovarian metastases occur in this way; as Bland-Sutton [9] says, the ovaries receive a light covering of falling cancer cells as evergreen shrubs are clothed by snowflakes in winter. It is important to realize at this stage that Krukenberg tumours are not the only metastases in the ovaries from carcinoma of the stomach. They are rare; the typical ovarian metastasis is an irregular nodular tumour which, histologically, closely resembles the primary growth, and it is probably true to say that these more common forms are produced by implantation. There are, however, many objections to this view. In the first place, as pointed out by Bucher, it is difficult to believe that implantations invade the covering epithelium of the ovary, and Schauta's hypothesis of the implantation occurring through the site of rupture of a Graafian follicle is not convincing. The question has been closely investigated by Sitzenfrey [24], who described a specimen of microscopic carcinoma invading the surface of the ovary, and by Kraus [4], who, in five cases of early metastatic carcinoma of the ovary, demonstrated a penetration of cancer cells into the substance of the ovarian cortex. Kraus concluded that metastatic carcinoma of the ovaries took place by means of implantation, and explained (as also did Bland-Sutton) the course of metastases in the ovary from cases of carcinoma of the breast by permeation along the lymphatics into the peritoneal cavity, and thence by implantation into the ovaries. Kraus carried out experiments on animals by injecting indian ink into the peritoneal cavity and subsequently examining the ovaries histologically; he succeeded in demonstrating particles of indian ink in the ovarian cortex. His experiments were repeated more accurately by Wolfheim [25], who showed that, although indian ink particles could be found in the ovaries, the particles were usually seen in the lymphatic channels and in the stroma; he pointed out that Kraus was not justified in drawing the conclusions at which he had arrived.

It is difficult to account for Krukenberg tumours by the theory of implantation, for it was shown by Kroemer that in such cases the peritoneum may be free from growth; this is illustrated by the first of the cases recorded in this paper. Again,

Krukenberg tumours are free from adhesions, have smooth surfaces and retain the shape of the normal ovary. If they are produced by implantation it would be expected that metastases would be found in the pouch of Douglas, which is the lowest part of the peritoneal cavity and, so far as I am aware, no such case has been recorded. Lastly, the histological form of the Krukenberg tumour differs so markedly from that of the primary growth that some explanation of this discrepancy must be given. It has therefore been suggested by Amann [10], Kehrer [26] and others, that the route is probably by way of the lymphatics. In cases of carcinoma of the stomach the retrogastric and then the superior lumbar glands are invaded, and the latter glands receive the lymphatics from the ovaries. The hypothesis assumes that there is a lymphatic blockage at the superior lumbar glands and that the cancer cells pass down the ovarian lymphatics by retrograde lymphatic spread—a process which, as Handley has shown, occurs in cases of carcinoma of the breast. This hypothesis explains why the growth is bilateral, why its surface is smooth and why it retains the form of the normal ovary, for it invades the ovary from its medulla and not from its surface. There is a certain amount of evidence in support of this view. It was shown by Krukenberg that the signet-ring cells are often found in lymphatic channels in these tumours, and Schottlaender pointed out that in early metastatic carcinoma of the ovary nodules of growth are frequently found in the medulla when the cortex is almost clear of growth. O. Frankl has communicated some very interesting observations on this matter. He points out that, in cases of ovarian metastases, the uterus and tubes are harder than normal, and he attributes this to lymphatic stasis and to secondary connective-tissue formation. Further, he has shown that in such cases metastases are found in the lymphatics of the wall of the uterus. That these uterine metastases were not secondary to an initial ovarian metastasis was shown by the fact that in thirty-six cases of primary ovarian carcinoma no metastases were found in the wall of the uterus, while out of seventeen cases of metastatic carcinoma of the ovaries in seven—a high percentage—such metastases were demonstrated.

It is also well known that the ovary may be invaded by carcinoma by way of the lymphatics from carcinoma of the uterus, and also from malignant disease of the opposite ovary. Lastly, this hypothesis explains why the alveolar arrangement is lost in cases of Krukenberg tumour, and why the signet-ring cells are usually isolated amongst the stroma cells, for in this hypothesis it must be assumed that single or only small bunches of cancer cells invade the ovaries.

As already stated, Krukenberg emphasized in his paper that the disease occurred in young women as well as in the aged. This is illustrated by the following table:—

	Age less than 20	21 to 30	31 to 40	41 to 50	51 to 60	61 to 70
Frankl [20]	—	0	9	—	—	—
Schmincke [27]	—	1	—	—	—	—
Roemer [28]	—	1	—	—	—	1
Reel [29]	—	1	1	—	—	—
Foulkrod [30]	—	—	1	—	—	—
Marchand [31]	1	—	—	—	—	—
Frankenthal [32]	—	—	2	—	—	—
Glockner [12]	—	—	1	—	—	—
Glockner [33]	—	1	—	—	—	—
Schenk and Sitzenfrey [34]	—	1	—	—	—	—
Krukenberg [1]	—	2	1	1	1	—
Krueger [35]	1	—	—	—	—	—
Major [36]	—	—	1	—	—	—
Outerbridge [18]	—	—	—	—	1	—
Schwartz [37]	—	1	—	—	—	—
Shaw	—	1	1	2	1	—
Total 35	2	9	17	3	3	1

That is to say, out of 35 cases only 7, approximately 20 per cent., occurred in patients over 40. This is a very striking feature of these tumours, especially when

it is remembered that carcinoma of the stomach occurs most often in patients over the age of 40.

Metastasis of carcinoma occurs very frequently in the ovaries relatively to other organs of the body, and this applies not only to carcinoma of the gastro-intestinal tract but also to carcinoma of the breast. It has been shown by von Torök and Wittschhöfer that ovarian metastases are found in about 10 per cent. of all mammary carcinoma that come to autopsy, and this frequency is high compared with the metastases occurring in other organs, and is approximately equal to the incidence of metastases of mammary carcinoma in the bones. In the usual type of Krukenberg tumour the ovaries are the main seat of carcinoma. The question is obviously not connected with the anatomical relationships of the ovaries, otherwise it would be expected that metastases in the testes in cases of carcinoma in the male would be common. It seems that there is some obscure relation between the activity of the ovaries in the child-bearing period and the incidence of metastases in these organs. Schöttlander, Frankl and Kraus have all suggested that the ovaries afford an excellent culture medium for these growths because of their rich lymphatic supply. This question in turn is probably related to the sarcomatous changes that occur in the stroma of the growths. Although it must be considered in the light of the present-day series of cases that the tumour is essentially a metastasis of carcinoma, the sarcomatous nature of the stroma must not be lost sight of. It was the dominance of these sarcomatous characters that led Krukenberg to believe that the tumours were connective-tissue in origin, and recently Marchand has brought forward evidence to support this view. The modern tendency, however, appears to be to neglect these sarcomatous changes in the stroma, but they can readily be recognized in the cases I have examined. They illustrate the extraordinary powers of cell growth of which the ovaries are capable, a growth which in the case of the developing corpus luteum is unrivalled in the body tissues.

Diagnosis and Treatment.

The diagnosis of malignant disease of the ovaries in these cases is usually made, for ascites almost invariably accompanies these tumours, but it is probably worth while to investigate such cases further before operation is performed. The mobility of the tumours—which is one of their main characteristics—may lead the operator to explore the abdomen, when an X-ray examination of the stomach together with examination for occult blood in the stools might indicate that the tumours were secondary.

Two cases are recorded by Schenk and Sitzenfrey in which, on bilateral solid ovarian tumours being found, palpation at operation revealed a carcinoma of the stomach. A surgical colleague was called in and partial gastrectomy carried out. Such treatment is very drastic, and it is doubtful whether it is justified. Modern methods of investigation ought surely to be employed in cases of malignant ovarian tumours, for a study of the cases recorded reveals that the immediate mortality of ovariotomy in metastatic carcinoma is extremely high, although, as in the case of Krukenberg tumours, the operation can be easily accomplished.

Conclusions.

(1) Krukenberg tumours of the ovaries are almost invariably metastatic and usually follow carcinoma of the stomach.

(2) Histologically, the tumour consists of signet-ring cells scattered throughout a sarcomatous stroma.

(3) The ovaries are probably involved by retrograde lymphatic spread from the superior lumbar glands.

(4) The tumours usually occur in women during the child-bearing period of life.

(5) Complete examination for disease of the stomach should be carried out before operation in cases of malignant ovarian tumours.

I have to thank Sir Charles Gordon-Watson, K.B.E., C.M.G., and Mr. Harold Griffith for records of cases, and Sir Bernard Spilsbury and Dr. T. H. G. Shore for the help they have given me in the preparation of this paper.

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Other references are to be found in the papers of ROEMER, OUTERBRIDGE, MAJOR and FRANKENTHAL.

Mr. T. G. STEVENS (President) said he considered that these tumours were more common than was generally thought. Not infrequently they were removed and looked upon as fibromata of the ovary without microscopic examination. Their histological structure was exactly that of the "leather-bottle" stomach, namely, a carcinoma composed of an embryonic stroma enclosing small alveoli of large epithelial cells, usually arranged in a single row of not more than three or four elements. The epithelial cells always showed a large vacuole which pushed the nucleus on one side and produced the well known signet-ring appearance. The embryonic stroma, which had often been wrongly looked upon as sarcomatous, was only a response of the ovarian stroma to an unusual stimulus supplied by the secondary epithelial growth. This stroma closely resembled that of many ovarian fibromata, in which the whole growth was often intensely cellular and yet not malignant in any sense. He (the President) had always regarded these tumours as the result of epithelial implantation, but in the light of modern opinion, as shown by Dr. Shaw, he considered that invasion via the lymphatic channels seemed highly probable. Secondary ovarian carcinomata might follow a primary growth in the stomach, intestine or breast, but in view of the histological characters of the Krukenberg tumour, he considered that the primary growth was always gastric, as a tumour of intestine or breast never had the peculiar characters usually found in these tumours. The most striking clinical feature was that the cases so seldom showed any gastric symptoms, but only came under observation when the abdomen began to enlarge from ascites due to the secondary growths.

[*February* 4, 1926.

Radiography in a Case of Triplet Pregnancy.

By G. F. ABERCROMBIE, M.B.

THE triple pregnancy to be described presents several points of interest, the most important being the method by which the diagnosis was made before labour.

Mrs. P., aged 35, had had one miscarriage at the third month in 1923; her second pregnancy went to term, and on December 31, 1924, after labour had lasted forty-five hours, she was delivered under anæsthesia, by forceps, of a seven-pound child. Prolonged artificial respiration proved successful, but on the following day the child had a fit, and continued to have fits at fairly frequent intervals until it died at the age of eight weeks.

When first seen on October 19, 1925, the patient stated that she had had no monthly period since the birth of her child, and that she had quickened two months previously, from

which data it was calculated that delivery might be expected in January, 1926. Examination showed the pelvis to be somewhat contracted, the external measurements being 9¾, 10, and 7¼ in. The promontory of the sacrum was easily within reach from the vagina at a distance of 4 in. The lie appeared to be transverse. Seen again on November 2, the uterus was already almost up to the xiphisternum, and in spite of the difficulty of gauging the duration of the pregnancy, and of determining the lie, owing to the presence of a considerable degree of hydramnios, the possibility of twins was suggested. An X-ray photograph taken with a Potter-Bucky diaphragm at St. Bartholomew's Hospital on November 5—that is, probably between the twenty-eighth and the thirtieth weeks of gestation—was reported on by Dr. Loughborough, as follows: "There are certainly two, if not three, heads present, one in the left hypochondrium, and one in each iliac fossa." An attempt a few days later to demonstrate fœtal electrocardiograms failed, and definite evidence of multiple pregnancy by auscultation of fœtal heart sounds was not obtained.

On December 2, at 2 a.m., the patient went prematurely into labour, and was admitted to the maternity ward of the New End Hospital, Hampstead, under the care of the medical superintendent, Dr. A. G. L. Reade, to whom I am much indebted for his courtesy in permitting me to observe and record the case. At 10.30 a.m., the cervix being fully dilated, the membranes were ruptured artificially, and after an hour a boy weighing 3 lb. 2 oz. was born—a normal easy breech delivery. The cord was divided between ligatures, but no placenta followed. As the labour pains continued, a second bag of membranes was ruptured at 12.45 p.m. The pains ceased almost immediately. Throughout the rest of that day and during the whole of the next, nothing whatever occurred, and the patient spent much of the time in undisturbed sleep.

On the morning of December 4, intensive treatment by Mr. Gordon Luker's method was begun: at 5 a.m. 2 oz. of castor oil, at 9 a.m. a hot enema, followed at 10 a.m. and again at 12 by intramuscular injections, each of 10 gr. of the bihydrochloride of quinine. Labour re-commenced midway between these two injections. At this time the patient was well and strong, her temperature and pulse-rate were normal, and no blood or meconium came from the vagina. At 4 p.m. she was examined under light anæsthesia; the cervix was not quite fully dilated, a second child presented as a right sacro-posterior with both legs extended, a third child lay transversely with the head to the left in the upper part of the uterus, a fœtal heart was heard. By 6.30 p.m. in spite of strong and frequent pains, there had been no appreciable advance; the cause of this delay was not, I think, interlocking of the children, but rather that the distension of the fundus by the transverse lie of the upper child prevented any adequate expulsive force being applied to the much narrower breech presentation in the pelvis. Moreover, the liquor amnii had drained away, and the uterus was becoming moulded to the shape of its contents. Accordingly a general anæsthetic was given, the whole hand passed into the uterus and after some difficulty the anterior leg of the breech presentation was flexed at the knee and brought down, and a boy weighing 3½ lb. fairly easily delivered. Next, the position of the third child was ascertained to be transverse with the head to the left and the limbs downwards. It was easily extracted as a breech, and proved to be a boy of 2½ lb. All three children were delivered alive, and respiration was quickly and spontaneously established. At no time during the delivery of the third child was a third bag of membranes encountered. It was thought wise to remove the placenta manually, and it was found to consist of a single mass, showing evidence of three amniotic cavities, and having attached to it three separate cords, one of them by a battledore insertion.

The puerperium was comparatively uneventful. The pulse-rate never rose above 104, and an evening temperature of 100° F. on the first two days gradually declined to normal at the end of the first week. Four hypodermic injections of sensitized *Streptococcus pyogenes* vaccines—type I—were given prophylactically. Of the children, the smallest died on the second day, and the next in size died on the fifteenth day. The largest, having survived a precarious descent in weight to 2¾ lb., regained its birth weight at the end of the fourth week, and at the present moment is breast-fed and gaining steadily.

This case is an admirable example of the very great value of X-rays in antenatal work. At a comparatively early stage of pregnancy, when all other diagnostic methods failed, the X-rays gave accurate information of the position and of the number of fœtuses present. The photograph shows two fœtal spines in the right hypochondriac region; the upper of these is continuous with the head in the left hypochondrium, the lower with the head in the left iliac fossa. Immediately below the shadow of the head in the right iliac fossa is the rather faint indication of the

third fœtal spine. As far as I have been able to ascertain from a search through the literature, triplets have been demonstrated *in utero* by X-rays on four previous occasions.[1]

Mr. W. GILLIATT said that he had had a case of triplets diagnosed, before labour, by X-rays at King's College Hospital in March, 1925. The circumstances of the case were a little unusual in that the patient was admitted a few days before full-term for very severe albuminuria of pregnancy. Twins were diagnosed, and it was decided to deliver her by Cæsarean section the next day. An X-ray examination of the uterine contents was made before operation and triplets diagnosed, two children presenting as vertex and one as a breech. The three children were delivered by Cæsarean section, weighing respectively, 5 lb. 6 oz., 4 lb. 4 oz., and 4lb., and all were of the male sex. He (Mr. Gilliatt) considered that X-ray examination of the pregnant uterus was of invaluable assistance to any patient in whom the baby could not be easily made out both as regards position and size. During the last month he had had a case of hydramnios in which it was impossible to make out any fœtal parts. X-ray examination revealed one child presenting by the head, and in three radiograms taken no vault to the skull could be seen, and a diagnosis of an anencephalic fœtus was made, which proved to be correct on delivery.

Hydronephrosis Eight Years after Ligature of the Ureter during the Operation of Hysterectomy.

By HERBERT J. PATERSON, C.B.E., M.C., M.D., F.R.C.S.

IN March, 1913, I performed total hysterectomy on a woman aged 43, for a large uterine fibromyoma. On opening the abdomen a large soft fibromyoma was exposed, the lower pole of which extended deeply into Douglas's pouch, where it was fixed firmly by atmospheric pressure, and was pulled up after considerable difficulty. Part of the tumour had burrowed between the layers of the right broad ligament, and the right ureter passed through the lower pole of the swelling which had apparently grown round and underneath the ureter. As dissection of the ureter would have been very difficult, if not impossible, and in any case would have entailed an extensive separation of the ureter, the wisest plan seemed to be to divide the ureter and ligature it above and below the fibromyoma. The fibromyoma was growing from the lower uterine segment and weighed 8 lb. The patient was quite well for three weeks (highest temperature 99·2° F.), when she had a rigor with a temperature of 103° F. After this she had several attacks of vomiting, with severe abdominal pain. Four weeks after the operation an elastic swelling was discovered in Douglas's pouch. It was opened through the roof of the vagina and a considerable quantity of serous alkaline fluid was evacuated. The fluid was not urine, and apparently was the result of a serous perimetritis. After this she made a speedy convalescence and remained quite well, except that occasionally she had incontinence of urine. Eight years later she began to suffer from pain after taking food, with a sensation of fullness. The pain was relieved by lying down. A swelling was found in the right lumbar region. With the cystoscope urine was seen coming from the left ureter, but no secretion from the orifice of the right ureter. A diagnosis of hydronephrosis was made, and the abdomen was re-opened. The right kidney had become a large thin-walled sac filled with fluid. The right ureter was dilated to the size of the small intestine and could be traced right down to the brim of the pelvis. The swelling was removed together with the ureter. The patient made an uninterrupted recovery and is now (four and a half years after the operation) quite well.

[1] (1) LARS EDLING, "Über die Anwendung des Röntgenverfahrens bei der Diagnose der Schwangerschaft," *Fortschritte auf dem Gebiete der Röntgenstrahlen*, 1911, xvii, p. 345. (2) ELIS ESSEN MÖLLER, "Un moyen de diagnostiquer avant l'accouchement une grossesse triple," *Gynécologie et Obstétrique*, 1920, ii, p. 145. (3) FAVREAU et DESPONS, "Radiographie d'une grossesse trigémellaire au 6e mois," *Bulletin de la Société d'Obstétrique et de Gynécologie*, 1924, xiii, p. 599. (4) SUNE GENNELL, "Un second cas de grossesse triple diagnostiquée par la radiographie," *Gynécologie et Obstétrique*, 1926, xiii, p. 41.

Examination of the specimen shows that the kidney had been dilated into a large sac, on the inner surface of which there is still some attenuated secreting surface.

The point of interest is that, contrary to what is taught in the text-books, the kidney continued to secrete in spite of ligature of the ureter. Possibly the explanation is this: when the ureter is tied close to the kidney, the back-pressure in the kidney causes immediate cessation of the secretion. When, however, as was done in this case, the ureter is tied nearer to the bladder, the pressure of the secreted urine is great enough to distend the thin-walled ureter, which becomes slowly dilated, so that the back-pressure in the kidney is never quite high enough to cause total suppression of urine. Therefore the kidney continues to secrete, although very slowly, as it has to secrete against the tension of the slowly dilating ureter. Owing to the constant back-pressure, the kidney substance becomes gradually atrophied and absorbed, and the kidney eventually becomes a mere bag of urine.

The lesson would seem to be that the ureter should have been tied close to the renal pelvis.

Dr. HERBERT SPENCER said that he had cut the ureter in performing hysterectomy for large myomata on two occasions. In one case he had brought out the ureter through the flank and drained and subsequently removed the kidney. He thought it likely that a careful examination of cases in which the ureter had been tied would show that hydronephrosis developed more frequently than was thought by some operators. In the second case he had implanted the upper end of the cut ureter into the lower end by the following method. A long, strong black thread transfixed the upper cut end, and one of the free ends of the thread was threaded into an eyed probe, and the two ends of the thread tied. The probe was then passed through the lower cut end of the ureter into the bladder. The lower end of the probe was guided by the fingers feeling through the bladder wall into the jaws of forceps introduced through the urethra. The probe and thread were then withdrawn through the urethra. By making traction on the thread the upper end of the ureter was invaginated into the lower, and the outer walls were stitched in position with fine silk. The thread was then cut and removed. Both the patients remained well after many years.

Pulmonary Tuberculosis Complicated by Pregnancy.

By A. LOUISE MCILROY, M.D., D.Sc.

LITTLE attention is paid in British text-books to the subject of tuberculosis associated with pregnancy, and there seems to be a lack of interest in the problem of the treatment of such patients from the obstetrician's point of view. Considerable experience has led me to the conclusion that pregnancy is a very serious complication of pulmonary tuberculosis.

Many questions arise when dealing with the treatment of patients, such as residence in a sanatorium throughout the pregnancy, labour and puerperium. The consideration of the avoidance of pregnancy and the uses of therapeutic abortion, the nursing and after-care of the infant also involve the serious consideration not only of the physician, but of the administrative authorities.

In France and America discussions have taken place on the subject, and the methods of treatment seem somewhat controversial, but all writers are in agreement as to the gravity of the condition. There are two aspects of the problem: (1) Ante-natal care, and care during labour and the puerperium; (2) post-natal care of the mother and infant.

(1) ANTE-NATAL CARE.

Effect of Pregnancy on Pulmonary Tuberculosis.—Treatment during Pregnancy.

Tuberculosis occurs most frequently among women during the reproductive period of life. It has little influence upon fertility nor does it bring on spontaneous abortion. A tuberculous lesion may arise during pregnancy, or the pregnancy may take place when the patient is suffering from an active lesion, or when the lung condition is quiescent, or healed. In my experience the case most frequently met

with is that in which there is a history of tuberculosis previous to pregnancy. In some the lesion may have become quiescent and only becomes active during pregnancy.

Primigravidæ are particularly susceptible to pulmonary changes, although frequent child-bearing may cause a breakdown in health, and subsequent tuberculosis.

Tuberculosis of the lungs arising during pregnancy as a rule manifests itself in the latter half by a slight cough or a general malaise. Either may easily escape the attention of the medical attendant, being ascribed to pregnancy. The chest condition is, perhaps, only diagnosed when the disease is seriously advanced. Hospital patients may attend an ante-natal clinic and a tuberculosis dispensary at the same time, and not inform the respective medical officers of the fact.

The idea that pregnancy improves the general condition of a tuberculous patient is quite a fallacy. Improvement may be thought to have occurred, but if the after-history is followed it is seen that this is not really the case, especially if laryngeal tuberculosis is present. Statistics are difficult to obtain, for patients, in mild cases, remain at home, and only enter a maternity hospital for the confinement, and if advanced are, as a rule, refused by most maternity hospitals, and, if admitted, are not always followed up after their discharge.

There is very little co-ordination between the maternity hospital and the sanatorium. Most cases are sent out of the sanatorium before labour is due because of the difficulty of providing trained obstetrical attention. The patient goes home and has a choice of remaining there, or of going into the infirmary. She gets more or less lost sight of just at the time when sanatorium treatment is most important.

Special departments in sanatoria or in special institutions should be provided for the care of these patients throughout the course of the disease. No interruption in the treatment should take place because of labour or the puerperium. As an alternative, a special department in a maternity hospital should be provided for the reception of patients for their confinements, the patient being sent back to the sanatorium directly the obstetrical care is terminated.

The Induction of Abortion.

Therapeutic abortion, in cases in which there is an active tuberculous lesion, is advised by a large number of physicians and obstetricians, more especially in the early weeks of pregnancy.

The desirability and propriety of therapeutic abortion are always difficult problems. In tuberculosis the difficulties are greater because the condition is not due to the pregnancy, as in cases of toxæmia. The trend of modern obstetrics is to limit the induction of abortion, and to treat the tuberculosis. Therapeutic abortion should never be a substitute for efficient treatment.

French physicians are divided in opinion as to the uses of abortion in tuberculosis. Bar is one of its strongest advocates. He insists, however, that the medical attendant should satisfy himself that the patient has undoubted tuberculosis, and that pregnancy has a bad effect on the disease. Also, it should be considered whether a cure is probable, and whether this would be possible if pregnancy were allowed to go to term.

British obstetricians are coming to regard abortion as a doubtful cure for any constitutional disease, and the results in tuberculosis are not convincing. Spontaneous abortion rarely occurs, therefore interference cannot be expected to exercise a great effect. The fœtus seldom dies in the uterus, and the children born of tuberculous mothers are usually healthy. The disease is rarely conveyed to the ovum. Isolated cases of placental and umbilical tuberculosis are reported, but these are very rare, and usually occur in advanced stages of the disease in the mother.

The ovum, however, may act as a parasite, draining the mother's vitality, and her life may be endangered thereby. When the disease has become active, will the removal of the ovum cause healing to take place? The induction of abortion in itself may cause decreased resistance, and rapid advance of the disease.

Bar advocates induction of abortion if the disease is curable, and has become worse since the onset of the pregnancy. Each individual patient must be given separate consideration. Much depends on the severity of the disease, its progress, and the conditions available for suitable treatment and after-care. A consultation should always be held with a physician. The life of a child must not be sacrificed unnecessarily, but, on the other hand, the danger to the mother must be fully appreciated. Consideration of induction of abortion should be limited in most cases to a pregnancy of not longer than twenty weeks' duration, as, after that, induced labour in the later weeks is a serious matter. In cases in which disproportion may cause undue suffering during labour, induction is sometimes advised after the thirty-sixth week. It is to be borne in mind that labours should be rendered as painless as possible for the patient.

In private practice open-air treatment with rest and good feeding should be adopted. In hospital practice it is sometimes found that the patients refuse to leave home or to undergo sanatorium treatment.

Therapeutic abortion should be only performed on the understanding that the patient will be kept under the care of a physician for some time afterwards, and that proper methods of treatment have been already tried and have been found inefficient in checking the progress of the disease. Induction in a multigravida is less frequently indicated than in a primigravida. The slow method of induction by tents without an anæsthetic is preferable to the rapid method of emptying the uterus.

Some cases, after labour, show rapid rise in temperature and the onset of acute symptoms. Sometimes there is a fatal termination in a few weeks or months, even in patients in whom there has been no evidence of tuberculosis at the beginning of pregnancy.

The question of lactation is controversial. It is quite possible that if the infant is born in a healthy condition it is immune to its mother's tubercle bacilli, and that her milk will not affect it. I have, however, no proof of this assertion. It is possible that the child may come in contact with dried sputum, and thus become infected ; and that for this reason lactation is a danger.

If the mother's tuberculosis is slight, and does not seem to be affected by nursing, I think it is advisable for her to continue suckling for three months at least, as this gives the child a good start in life. If, however, the mother shows any exhaustion after nursing it should be discontinued. Lastly, it is evident that if the mother is severely ill, lactation is absolutely contra-indicated.

(2) After-care of Mother and Child.

Obviously it is important that recently pregnant patients suffering from tuberculosis should receive proper treatment in the open air, and that the infants of these patients should be guarded from infection by isolation from the mother.

One point, however, must be considered by the obstetrician, viz., the question of further pregnancies. These should be avoided so long as any active pulmonary lesion is present, and for a duration of at least two years after all symptoms have subsided. The use of contraceptives may be advised in cases where celibacy is impossible. Temporary sterilization by means of X-rays may be employed, but its application has not been sufficiently long in use for me to speak with confidence of its merits. It certainly seems a more beneficial method than permanent sterilization by operative measures.

In the Royal Free Hospital Obstetrical Unit, when tuberculosis is diagnosed in the ante-natal clinics, the patient is put under the care of a physician or sent to a

sanatorium. If the latter treatment is not possible, owing to the pregnancy being near term, the patient is taken into the medical wards, or failing this, into the maternity wards for rest and observation. When the labour and puerperium are over, the patient is followed up by the lady almoners, and treatment suitable to the condition is carried out.

No patient is refused admission for confinement because of her pulmonary condition. She is isolated, as much as possible, in the corner of the ward close to an open window.

The following tables give a brief outline of eighteen cases on which these remarks of mine are based. In every case the patient has been seen by a physician for the diagnosis and treatment of the tuberculous lesion, either before or during pregnancy. I am much indebted to the physicians of the Royal Free Hospital for their help in consultation.

No.	Age and parity	Week 1st seen	Lesion before Pregnancy			Effect of pregnancy	Labour	Result
			Apex	Sputum	Hæmoptysis			
I	21 P	22nd	R. L.	+	+	Much worse	—	Died at 32nd week; acute T.B.; infirmary
II	31 M3	Term 3 years ago	Healed R.	—	—	Never felt well	N.	Fairly well; still coughing; sent home
III	19 P	32nd 2 years ago	R. extensive	+	+ 2 yrs. before sanatorium 3 months	Laryngeal complication	N.	Sent home
IV	30 P	38th	—	—	—	Quite well till 20th week; R. and L. apices, sputum + in hospital	N.	Died in medical hospital a few weeks later
V	32 M1	24th 7 mths. ago	7 yrs. after birth of child in sanat.; 2½ yrs. R. L.	+	+	Inactive 1 fibrosed	N.	In sanatorium keeps well
VI	22 P	36th in labour	Healed R.	+	—	Much worse; lesion active	N.	Refused sanatorium. Died 4 weeks later in hospital
VII	33 M1	22nd 4 years ago	R. L. attended Brompton	—	—	Worse since pregnancy. Lesion active. Laryngeal	N.	Went to sanatorium. Died at home one year ago
VIII	28 P	35th 1½ yrs. ago	Cough for yrs. R. L.	+	+ 3 years ago	More easily exhausted	F.	Refused sanatorium. Attended T. B. dispensary. Not improving
IX	33 M1	20th 4 years ago	L. slight	—	—	Some activity. Slight hæmoptysis. Sanatorium not available	N.	Sent home. Keeps fairly well
X	28 M3	28th 1½ yrs. ago	None	—	—	Worse since onset; L. apex affected	N.	Sent home; condition unchanged
XI	45 M3	26th 1 year ago	Cough for years. R. old pleurisy	—	—	Worse since onset	N.	Sent home, condition fair
XII	24 M1	27th 4 years ago	None	—	—	Slight lesion; R. and L. apices	N.	Lost sight of

No.	Age and parity	Week 1st seen	Lesion before Pregnancy			Effect of pregnancy	Labour	Result
			Apex	Sputum	Hæmoptysis			
XIII	35 M4	27th 2 years ago	Lesion since 16; worse since pregnancy	—	—	Worse	N.	Sent home. Pregnancy 1 year later. Abortion induced, said to be pregnant again
XIV	34 P	30th 1 year ago	Lesion in childhood; sanatorium 8 yrs. ago; passed by doctor for pregnancy. R. L.	—	—	R. L. old lesions	N.	In sanatorium improving
XV	30 M3 1 misc.	30th 7 mths. ago	L.; was in sanatorium; pleurisy	—	—	Little change	In 36th week N.	Sent home. Fairly well
XVI	32 M4	34th 3 mths. ago	R.	—	+	Worse; was in sanatorium, sent out as pregnancy advanced; taken into hospital	N.	Sent home; refused sanatorium, attends T. B. dispensary; fairly well; Bad h. c.
XVII	31 P	30th 3 weeks	Cough since 20; hæmoptysis 5; pleurisy 1919; R. fibrosed; L. slight	—	+	Worse; was in sanatorium. Home under doctor; sanatorium impossible later owing to pregnancy	N.	Treated with vaccine; under observation at home
XVIII	28 M2	8 weeks	R. L.; was in Brompton; worse after last pregnancy	+	+	Cough worse; losing weight; hæmoptysis severe; artificial pneumothorax	Abortion induced; still in hospital	

1 case died undelivered.
2 cases still pregnant.
9 babies artificially fed.
5 babies breast-fed.
1 baby died in few weeks; healthy at birth.
Mother died.

All babies healthy at birth.
12 gained weight in hospital.
3 slight loss.
Abortion induced in 2 cases:—
(1) at 8th week.
(2) at 18th week.

Primiparæ	7 cases
Multiparæ	11 ,,
Sent from physicians	10 ,,
Found at antenatal clinics	8 ,,
Lesions previous to pregnancy:—	
Healed	6 ,,
Active	9 ,,
Lesions in pregnancy	3 ,,

Deaths:—

(1) Primipara: undelivered 34th week, much worse in pregnancy.
(2) Primipara: few weeks after labour. No lesion at onset of pregnancy.
(3) Primipara: healed lesion active in pregnancy four weeks afterwards.
(4) M1 went to sanatorium. Died at home a year later.

Worse	9 cases
Improving in sanatorium	2 ,,
I.S.Q. (1 lost sight of)	2 ,,

Discussion.—Dr. HERBERT SPENCER said he disagreed with the writer of the paper on the question of inducing labour in these cases. He was surprised to hear it suggested that it was only recently that British obstetricians were objecting to the operation. More than thirty-six years ago, in the Obstetrical Society of London, the question "Should Pregnancy be terminated prematurely in cases of Phthisis?" was raised by the late Dr. William Duncan. A very full discussion took place in which the operation was condemned (for reasons which remained equally valid to-day) by all the leading obstetricians of the time—Matthews Duncan, Priestley, Playfair, Herman, Cullingworth, Champneys, A. Routh, &c. (*Trans. Obst. Soc.*, xxxii, 1890, p. 7). The fact that an obstetrician was asked by a general physician to induce abortion was no justification for his doing it. He (the speaker) had been asked to do it and had always refused, as did Dr. Cullingworth in the case which gave rise to the discussion.

It was certain that in some cases the patient's condition improved during pregnancy and that the children were usually strong and healthy; in some cases the condition became worse; but no one would say with any certainty that abortion would improve matters or be justified in deciding that because the mother *might* be killed by the disease the child *should* be killed by the doctor.

Some general physicians were apt to pretend a knowledge of the course and prognosis of these cases which they were far from possessing, a good example of which had been published in the *Bull. de la Soc. d'Obst. et de Gyn. de Paris*, 1924, p. 568. He (Dr. Spencer) would regard it as regrettable if there were expressed by this Section a general approval of the induction of abortion in cases of phthisis complicating pregnancy.

Miss D. C. LOGAN expressed great appreciation of Professor McIlroy's very interesting paper. She asked to be allowed to make a few remarks from another point of view than that which had hitherto been brought forward.

She had a vivid recollection of a phthisical patient desperately ill admitted into a Maternity Hospital in 1917, who delivered herself of a full-time healthy infant though rapidly going downhill herself and dying of generalized tuberculosis within a couple of weeks of labour. Nature's care of the race at the expense of the individual seemed emphasized by such a case. In the subsequent eight years, in the course of seeing some 6,000 ordinary ante-natal and post-natal patients at Welfare Centres where there was the usual proportion of definitely diseased (cardiac, tuberculous, syphilitic, renal, diabetic, &c.) among the healthy women, she had gained the impression that with proper ante-natal and post-natal care, pregnancy need not be so great a calamity, at any rate in the earlier cases of tuberculosis. She (Miss Logan) said it was not possible to state offhand the number of such cases seen, but possibly a larger than average proportion of early cases was found, because, with the kindly co-operation of the tuberculosis officer, any patient complaining of cough which did not rapidly clear up with simple treatment, and any case of otherwise unexplained debility, had been referred to the tuberculosis dispensary for overhaul.

Any patient under six months pregnant in whom active lesions or tubercle bacilli were found, was sent if possible for six to twelve weeks into a sanatorium. When this was not possible, or, when the patient refused to leave home, the best treatment and care under these circumstances was arranged for her. There had been no deaths from tuberculosis among these cases; and no case requiring induction of abortion or premature labour. Deliveries had been uneventful, the infants healthy, and the large majority completely breast-fed.

The history of one patient illustrated a severe case followed by a satisfactory result: a primipara, aged 40, old tuberculous spine with deformity; active tubercle in lungs; pleuro-pericardial adhesions causing cardiac embarrassment. She went to full term, and produced a healthy child which progressed well, being breast-fed for nine months. The mother's condition at the end of this was better than when first seen at about the fourth month of pregnancy.

In a district with a well organized public health department the notification of tuberculosis and of births made it possible for the trained health visitor and the tuberculosis nurse to visit cases. As a result of these visits, together with the help and advice given at the Maternity and Child Welfare Centre, it was a most unusual event for a young infant to be found sleeping in the parents' bed in either healthy or tuberculous cases—even where overcrowding or poverty were unusually marked it was almost always possible to provide some sort of separate sleeping accommodation for the infant.

Section of Obstetrics and Gynæcology.

President—Mr. T. G. Stevens, F.R.C.S.

Carcinoma Adenomatodes Cervicis Uteri.

By Herbert R. Spencer, M.D.

Abstract.—*The case is one of carcinoma adenomatodes (adenoma malignum) cervicis uteri, which occurred in a patient, aged* 49. *Vaginal hysterectomy was performed with the Pacquelin cautery, and the patient remains well after* 22 *years. Attention is drawn to the rarity of the disease, and the point is emphasized that in true cases of the disease the glandular epithelium is nowhere proliferated, and therefore reliance on microscopic examination alone for the diagnosis may lead to serious error.*

Carcinoma adenomatodes (*adenoma malignum*) of the cervix is rare.

A great deal of confusion has arisen owing to certain authors including under the term *adenoma malignum*, and also under the term *adenoma destruens*, cases in which at least part of the glandular growth has its lining epithelium proliferated. Such cases are not very rare, especially in the body; they are adeno-carcinoma, but not the disease with which this communication is concerned.

Carcinoma adenomatodes of the cervix is characterized by glands resembling normal cervical glands and lined throughout by a single layer of columnar epithelium; this glandular growth invades the tissues and may give rise to secondary growths with a similar structure (Veit and John Williams). The old term *adenoma malignum* was not acceptable to pathologists, an adenoma being essentially a benign growth. I therefore introduced the term *carcinoma adenomatodes*, under which name the disease is described in the Gynæcological Catalogue of University College Hospital (1911). It appears to be a better and more distinctive title than *Carcinoma adenomatosum*, by which it has also been known (Aschoff).

Forty years ago (1886) John Williams, in his "Harveian Lectures[1] on Cancer of the Uterus," published two cases of the disease, one occurring in the cervix, the other in the body, and since that date very few cases have been published which on investigation proved to be genuine examples of this disease. The following is the only case I have met with in the cervix.

Mrs. F., aged 49, consulted me in July, 1903. She had had four children and one miscarriage; her last pregnancy had occurred sixteen years previously. Her labours had been normal, lasting about twelve hours; she had had chloroform at her confinements, but does not think instruments were used.

Menstruation had commenced at the age of 13. It had been regular, though profuse, up till the present illness, except on two occasions when she was abroad—at the age of 15 in Germany, and at the age of 23 in Holland—on which occasions it was irregular.

There was no history of tumour or cancer in the family. Her father died of influenza at the age of 73, her mother was living at the age of 78 in fair health, but rheumatic. She had three brothers living and in good health, and had had three sisters, of whom one only had died (of "ulceration" after typhoid fever).

[1] Published at the time in the *Lancet*, and in book form with illustrations, in 1888.

The patient's husband had been suffering from consumption for eighteen months, and during that period had slept apart from the patient; there had been no sexual connexion for some years.

The patient had had good health till the present illness, which she dates back two years. About four years ago she began to lose more at the periods; two years ago, she bled continuously for three months, and during the rest of the year she bled every fortnight, losing a good deal at times. During the year 1902 menstruation had been irregular in its occurrence and in amount. Again, in the spring of 1903, menstruation was irregular; on one

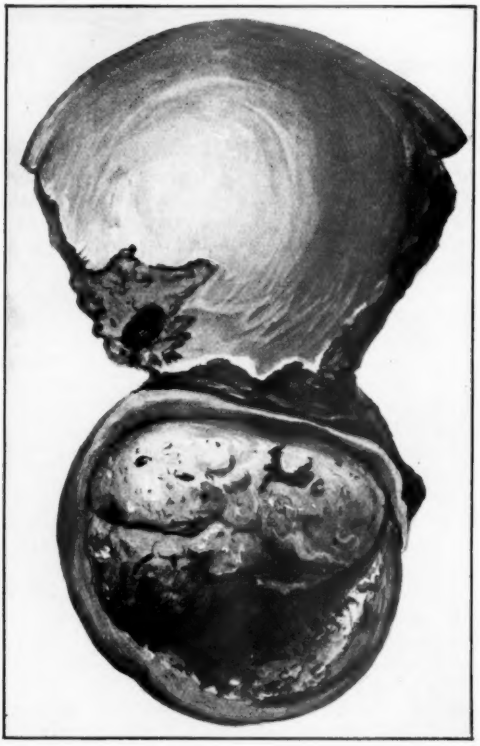


FIG. 1.—Carcinoma adenomatodes ("malignant adenoma") of cervix. Uterus removed by vaginal hysterectomy; drawing (natural size) by the author, showing extensive growth on the anterior lip and smaller ulcerated growth on posterior lip.

occasion the patient went six weeks without any loss and then had a severe hæmorrhage. For about two years she had noticed a watery discharge, which had had an offensive odour on two occasions. Previous to her illness she had never had any intermenstrual discharge.

The patient lived in the country and had been attended by an experienced general practitioner, who diagnosed cancer of the cervix and obtained her admission to a provincial hospital, the officers of which differed in their diagnosis, one saying that the growth was malignant, the other that it was benign. A piece of the growth was therefore sent to the Clinical Research Association where it was reported upon by the late Mr. Targett as "an innocent adenoma." Owing to the difference of opinion as to the diagnosis, the patient's brother, who was a major in the Army Medical Service, brought her to London to consult me.

The patient was anæmic, but in fair general condition. On examination the cervix was greatly enlarged by a growth affecting both lips, but especially the anterior lip where it extended to the fornix (figs. 1 and 2). It was a typical malignant growth, bleeding profusely and breaking down on pressure. As the section of the growth showed no proliferation of the glandular epithelium it was diagnosed as *carcinoma adenomatodes*. The body of the uterus was slightly enlarged, but freely movable. There was no fixation or thickening of the broad or utero-sacral ligaments. I removed the uterus by the vaginal route with the Pacquelin cautery on July 17, 1903. Owing to the difficulty of ligating the left uterine artery a pair of forceps was left on it for three days. The upper parts of the broad ligaments were tied with

FIG. 2.—Carcinoma adenomatodes ("malignant adenomas") of cervix. Uterus in mesial section; drawing (natural size) by the author, showing extent of infiltration of growth up to fornix on anterior lip and in the wall towards the internal os; the smaller growth on the posterior lip ulcerated.

thick silk ligatures, left long; the peritoneum was sutured and iodoform gauze was inserted in the vagina. The ligatures were removed on the eighteenth day. The patient made a simple recovery. She has been seen and examined by me on several occasions since the operation. I received a letter from her on November 9, 1925, stating that she remained well, over twenty-two years after the hysterectomy.

Description of the uterus.—The uterus measures 10·5 cm. in length, the body measuring 5 cm. in length, 6 cm. in breadth and 4 cm. in thickness. The cervix measures 5·5 by 5 by 4·7 cm. With the exception of a minute tag of lymph on the peritoneum the

body is normal. The cervix is enormously enlarged by a growth which involves the whole of the anterior lip and measures 4·5 cm. transversely, 3·5 cm. antero-posteriorly and projects for 1·7 cm. beyond the level of the posterior lip. The posterior lip also is the seat of an ulcerated growth, part of which has been removed by the cautery. The surface of the growth is slightly uneven and cleft in places, and towards the canal is rough and granular. On making a section of the uterus the growth is seen to infiltrate both lips, but especially

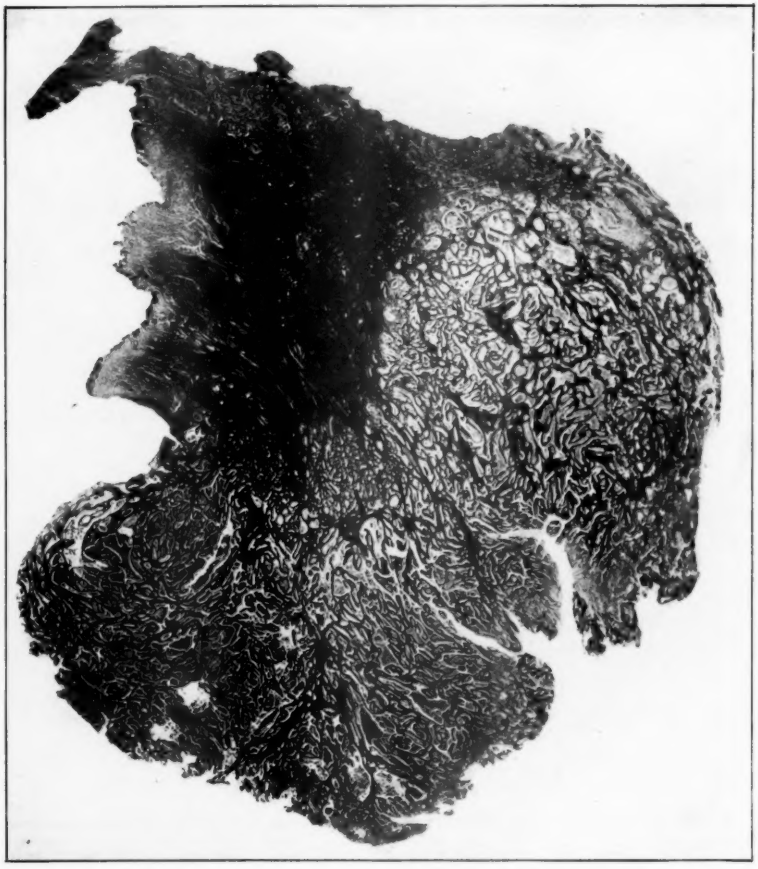


FIG. 3.—Photograph of large section of anterior wall of cervix (enlargement 4 diameters). The deep cleft on the left side is the anterior fornix. Below this a shell of the stratified epithelium still remains, although the growth has extended up to it (see fig. 4). Extensive growth deeply infiltrating the (mainly fibrous) stroma is seen composed of glands filled or dilated with secretion. Gland-epithelium everywhere in one layer.

the anterior, in which it extends up to the anterior fornix within 4·5 mm. of the cut vagina in the hardened specimen. It also infiltrates the posterior part of the anterior wall to a height of 3 cm. from the lower extremity of the anterior lip and runs up the posterior wall, where it is much less extensive, to 2·7 cm. above the edge of the posterior lip. The section of the growth is somewhat spongy. The rest of the mucosa of the cervix and body is normal.

Microscopic structure.—The growth is *carcinoma adenomatodes*, being made up of tubules and spaces, some dilated and filled with secretion, lined with cubical or columnar epithelium, which everywhere is in a single layer with no tendency to proliferate. The spaces are separated by a moderate amount of fibrous stroma which is, particularly near the advancing edge, infiltrated with small round cells. The epithelium varies, according to the pressure to which it has been subjected, from tall columnar to cubical. The cells and their oval or round nuclei lightly stained are well shown in fig. 6. They are similarly stained in the section stained with logwood.

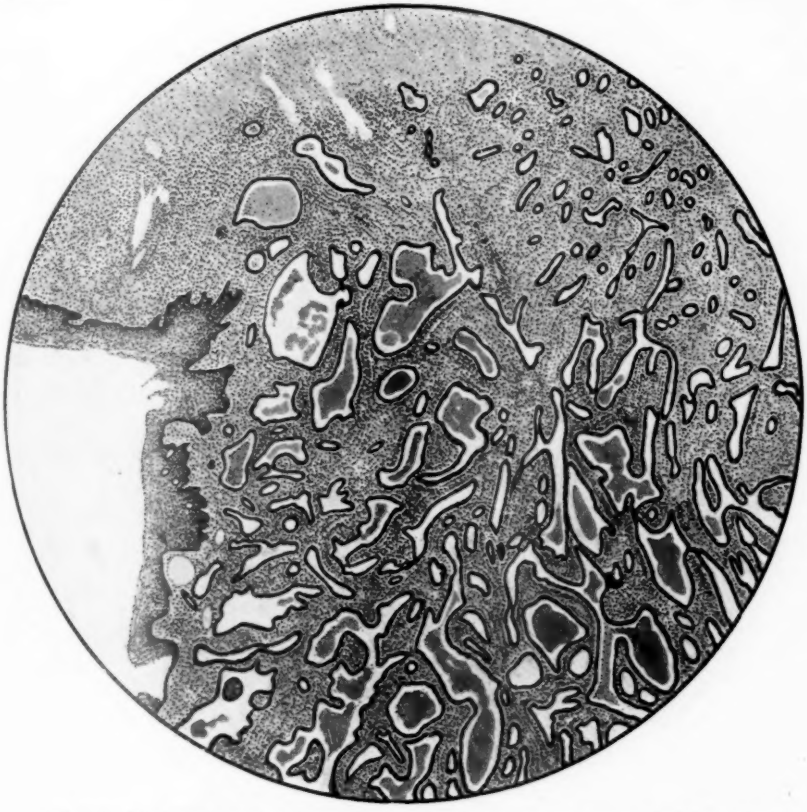


FIG. 4.—Microscopic section of growth in anterior lip (low power); camera lucida drawing by Mr. Ford, showing anterior fornix and growth. Some small-cell infiltration: advancing edge above the fornix also showing simple glandular growth. Below glands distended with secretion and penetrating almost to the stratified epithelium of the anterior wall of the portio.

Cullen,[1] to whose great work, "Cancer of the Uterus," every gynæcologist is greatly indebted, is disappointing in his brief chapter on "adenoma malignum," of which he had not personally met with an example. After giving the description of the disease from Ruge and Veit, in which it is stated that "the glands of the growth are lined with one layer of delicate cylindrical epithelium," and after

[1] Cullen, "Cancer of the Uterus," 1900, p. 305.

mentioning cases published by other observers, some of which do and some do not conform to this definition, he gives an excellent description and illustrations of a case (Dr. Kelly's) under the title "Adeno-carcinoma of the cervix (malignant adenoma)" in which the epithelium is not only proliferated, but has given rise to large secondary masses of epithelium like an ordinary carcinoma. The epithelial cells of this case "have fairly uniform small round or oval deeply staining nuclei and it is impossible to differentiate the protoplasm of one cell from its neighbour." It is clear from this description that the growth is an adeno-carcinoma but is not a *carcinoma*

FIG. 5.—Microscopic section of growth in anterior lip (higher power); camera lucida drawing by Mr. Ford showing general structure of the bulk of the growth. Epithelium everywhere in one layer, the thickenings in places due to tangential section.

adenomatodes (malignant adenoma) in which the epithelium is not proliferated, the nuclei do not stain deeply and the cells are clearly differentiated from each other (see fig. 6 and John Williams *loc. cit.*, plate 7).

As far as I have been able to ascertain, the following are the only authors who have published pure examples of the disease: Veit (second case) [1], John Williams [2], Gebhard (first case) [3], Schottlaender and Kermauner [4], Knauss and Camerer [5], F. J. McCann [6].

I would again insist that only cases in which there is no proliferation of the epithelium should be published as cases of *carcinoma adenomatodes* and that it is the simple appearance of its epithelium and the absence of proliferation which give the disease its chief pathological and practical interest.

FIG. 6.—Microscopic section (high power); stained with van Gieson; camera lucida drawing by Mr. Ford, showing the epithelium, stroma (mainly fibrous) and small-cell infiltration. Epithelium everywhere in one layer; above two glands cut in tangential section. Epithelium columnar; cell walls well marked; nuclei lightly stained (the same is shown in sections stained with logwood and eosin).

REFERENCES.

[1] RUGE and VEIT, *Zeit. f. Geburtsh. u. Gyn.*, 1882, vii, p. 170 (Veit's second case; his first case contained solid epithelial strands). [2] WILLIAMS, J., "Cancer of the Uterus," 1888 (case xi, plate 7). [3] GEBHARD (case i), *Zeit. f. Geburtsh. u. Gyn.*. 1895, xxxiii, p. 443. [4] SCHOTTLAENDER and KERMAUNER, "Zur Kenntnis des Uteruskarzinoms," 1912 (case xiii, in which an early squamous carcinoma was also present). [5] KNAUSS and CAMERER, *Zeit. f. Geburtsh. u. Gyn.*, 1896, xxxiv, p. 446. [6] MCCANN, F. J., "Malignant adenoma (carcinoma) of the cervix uteri," *Trans. Obst. Soc. Lond.*, (1898) 1899, xl, p. 2. The case is briefly reported: the growth was composed of tubules lined with a single layer of columnar epithelium. The patient died within six months of the operation (vaginal hysterectomy) with growths in the pelvic cellular tissue and (probably) in the liver. I had overlooked this case when the paper was read.

Dr. F. J. McCann said that at the Obstetrical Society in 1898[1] he showed a specimen of what he termed malignant adenoma of the cervix uteri. The patient was aged 46 years, the mother of three children. Her uterus was enlarged to 1½ in. above the symphysis pubis and was distended with mucoid material, slightly blood-tinged. The cervix was nodular and excavated, forming a crateriform ulcer at the apex of the vagina, the cancerous growth spreading to the bladder anteriorly. Vaginal hysterectomy was performed on June 28, 1897. The disease recurred locally, and secondary deposits invaded the liver, causing her death on December 9, 1897.[2] At the meeting at which the specimen was shown the opinion was expressed that this form of cancer was probably not so malignant, but in this instance, at any rate, recurrence was rapid. This case was described in his (Dr. McCann's) book on "Cancer of the Womb," p. 131.

A Method of Endoscopic Examination of the Uterus, with its Indications.

By Harold F. Seymour, F.R.C.S.Ed.

Since Nitze devised the cystoscope in 1879, most of the accessible cavities and passages of the body have been explored by endoscopic means.

I believe that Charles David was the first to describe a technique of endoscopy of the uterus, which he did in a Paris Thesis in 1908. He described an instrument consisting of a sheath into which fitted a cystoscope closed at the far end by a glass crystal and containing near it an incandescent lamp. By enclosing the lamp he thought he would avoid blurring of the visual field, due to bleeding following the introduction of the instrument. No satisfactory work seems to have been done with this apparatus.

Dr. Rubin, of New York, has described in the *American Journal of Obstetrics and Gynæcology*, September, 1925, the technique which he has been employing during the last few months in making endoscopic examinations of the uterine cavity. The hysteroscope which he has used (now shown) is a modification of the cysto-urethroscope as devised by McCarthy.

Dr. Rubin, in making his observations, which he does without anæsthesia, uses insufflation of the uterine cavity with carbon dioxide gas, his apparatus for inflating the Fallopian tubes being connected up to the hysteroscope.

The instrument is well adapted for passing through the cervix, the calibre of the periscope being 10·5 French catheter scale, with a sheath equal to No. 15 of the same scale. There is also an operating instrument with a sheath of No. 22 scale, and with space enough to permit the passage of such instruments as intravesical scissors. It is a complicated apparatus, and can only be used where gas inflation is not contra-indicated.

Now gas inflation of the uterine cavity is contra-indicated: (1) in the presence of acute or subacute inflammation of the adnexa which the gas inflation might aggravate; (2) in the presence of purulent discharge from the uterine cavity, lest infection be carried upwards through the tubes into the peritoneal cavity.

Now, if it is wished to inspect the endometrium at all, surely one would desire to do so on many occasions when there is a septic discharge coming away from the uterine cavity such as is found in the case of carcinoma of the body of the uterus, or, say, a sloughing submucous fibro-myoma. Therefore Rubin's hysteroscope does not specially commend itself to me.

Patients in England are not so docile as those in America, and do not bear so well manipulations which may be decidedly uncomfortable without anæsthesia. When I visited several gynæcological clinics in America two years ago, I admired the fortitude of the patients, and was envious of the complete and unreserved trust which they manifested towards their surgeons.

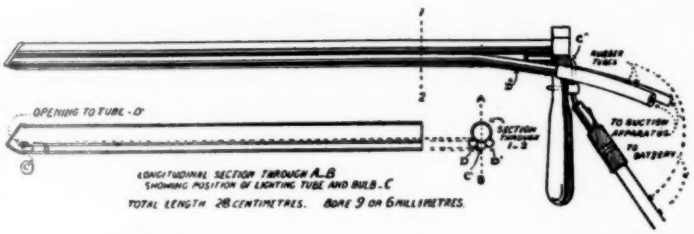
[1] *Trans Obst. Soc. Lond.*, (1898) 1899, xl, p. 2.

[2] Sections made from the growth showed that it was composed of tubules lined by a single layer of columnar epithelium, the interstitial tissue being of a fibro-cellular character and varying in amount.

Last May, some months before I had heard of Rubin's endoscopic work, I began to try various means of inspecting the endometrium. I first used a tube, angled like a uterine sound, to facilitate introduction through the cervix after it had been dilated in the usual way *under anæsthesia*. The tube, after introduction, was straightened out by a device which retained it fixed in the straight position. The light was at the proximal or ocular end, reflected into the tube by a mirror, as in one type of sigmoidoscope. With this instrument I obtained some views of the endometrium, but they were only fleeting views, as the blood and mucus that were oozing out soon obscured the view. Even using swabs on a long holder was insufficient to control this oozing.

After the examination of a few cases I soon found that it was unnecessary to employ an angled tube, as a straight one is easily introduced after the cervix has been dilated up to 10 or 12 mm.

The next problem, after resolving on the use of a straight tube, was to obviate the obscuration of the view by blood and mucus. Constant irrigation by sterile water or saline did not solve the difficulty, as it was found impossible to get rid of air bubbles which intercepted the view. The use of continuous suction was suggested to me by what I had seen at the Bronchoscopic Clinic of Dr Chevalier Jackson in Philadelphia. I borrowed a 6 mm. bore bronchoscope tube of the Jackson model, which has a lamp at the distal end; it is also provided with a suction tube. With this I obtained an excellent view of the endometrium. But a bronchoscope


OPENING TO TUBE - O
RUBBER TUBES
TO SUCTION APPARATUS
TO BATTERY
LONGITUDINAL SECTION THROUGH A-B
SHOWING POSITION OF LIGHTING TUBE AND BULB - C
TOTAL LENGTH 28 CENTIMETRES. BORE 9 OR 6 MILLIMETRES.

tube was too long for my purpose, and I also felt that the diameter of the bore should be at least 9 mm. This width was necessary for proper inspection and to enable a pair of suitable forceps to be passed up, and a snipping taken of any growth seen for pathological examination and report.

Accordingly, I asked a firm of surgical instrument makers in Philadelphia to construct for me suitable tubes for uterine work. There are two of these, each 28 cm. long, with a bore of 6 mm. and of 9 mm. respectively. The 2-volt light is at the distal end and is run off a dry battery.

The distal end, which carries the light close to the opening, is bevelled at an angle of 45°, and the edges are beautifully rounded off so that there is nothing to injure the endometrium. There are three channels in the brass wall of this tube, one for the rod which carries the light and one on each side for suction. If necessary, one suction tube can be used for irrigation, and adrenalin solution can be run in, if need be (see fig.).

When in use the suction channels are connected by rubber tubing to a bottle with a rubber cork, which is kept in a state of partial vacuum by means of an electric suction apparatus. The one I have found satisfactory is the Mennell pump; this can be used with any voltage, which is a great advantage. The 9 mm. tube is intended for general use, the smaller 6 mm. tube being reserved for small uteri or the atrophic post-climacteric uterus.

For an endoscopic examination the patient is prepared by placing a glycerine tampon against the cervix for two successive nights in order to render dilatation easy. The cervix is then slowly dilated up to the $\frac{9}{12}$ dilator. The hysteroscope is then gently introduced, a small swab on a sponge holder, specially made, being used as an obturator. This prevents blood running into the tube and thus obscuring the lamp during the passage through the cervical canal. The suction apparatus should be set going previous to the introduction. When the instrument is passed almost to the fundus, the swab on its holder can be withdrawn, and only introduced again should the lamp become smeared.

With the suction apparatus working briskly, the lamp end of the tube only requires swabbing out three or four times during an examination. The whole endometrium is then carefully scrutinized by turning the instrument about and by partially withdrawing and re-inserting the lighted end. With this apparatus, one has to examine the endometrium piecemeal. There is an aluminium handle to the instrument which is intended to give one direction during use. It needs considerable practice to learn to recognize what one sees, in the same way as practice is required in order to become an expert cystoscopist.

The following are the main points of the technique, which it will be no doubt agreed is very simple :—

(1) The cervix must be dilated up to the $\frac{9}{12}$ dilator in order to take the full-sized tube.

(2) The examination is made under general anæsthesia.

(3) It is a direct vision observation ; one could obtain a magnified image with a lens at the ocular end of the tube. But Rubin's hysteroscope gives an indirect magnified image.

(4) Suction is necessary at the beginning of the examination, but this can be shut off towards the end ; a little swabbing is necessary.

(5) It is easy to remove a piece of tissue by sight for pathological examination.

I recognize that endoscopy of the uterus has only a small field, but this is a very definite one. It can only be of use to the specialist on account of the practice required to interpret the appearances seen.

The indications for a hysteroscopic examination are the following :—

(1) Where a diagnostic curettage is indicated a hysteroscopic examination is likely to help. A diagnostic curettage is often disappointing. The report by the pathologist on the scrapings sent to him are not always correct because he may not have received the right piece of tissue. It is therefore much better to remove a piece of the growth by actual sight.

(2) Where there is uterine hæmorrhage—either menorrhagia or metrorrhagia—and nothing abnormal can be felt on bimanual examination, the diagnosis can be cleared up by means of the hysteroscope.

(3) Hæmorrhage from the uterus after the menopause, or a purulent discharge. Here a carcinoma of the body can be seen, a snipping of the growth taken and a diagnosis made between a degenerating fibroid and a carcinoma.

(4) In certain cases some might be in doubt as to whether to treat a case of hæmorrhage by hysterectomy, by X-ray therapy, or by the insertion of a radium tube. Here the scrutiny of the endometrium will assist in arriving at a decision.

Having examined some thirty cases with the hysteroscope I am only just beginning to learn the appearance of the normal endometrium and to recognize a few morbid conditions which I have so far met with. I am hoping shortly to get an artist to draw in colour what is seen under the hysteroscope, photography being useless for this purpose.

A Case of Pregnancy complicated by Ureteric Calculus.

By C. S. Lane Roberts, F.R.C.S.

Urinary complications during pregnancy are usually of interest, so that perhaps a few notes on the following case may not come amiss.

M. H., aged 27, was a primigravida, who gave no previous history bearing on the case and had her last monthly period at Christmas, 1924. When four months pregnant her doctor treated her for a slight attack of pyelitis from which she recovered.

Between the seven and a half and eight months of pregnancy there developed pain in the back, œdema of the ankles, legs and thighs, and the quantity of urine passed began gradually to diminish. These symptoms commenced on July 25, and finally on the evening of July 26 the urine became suppressed altogether, and there was some slight nausea with headache.

On July 28, evening, patient, affirming she still had passed no urine, was admitted to hospital, looking fairly well, and in no apparent distress, the uterus, on examination, feeling about thirty to thirty-two weeks pregnant.

On July 29, at 2 a.m., she was catheterized, 1 oz. of urine being removed: at 11 a.m., on re-catheterization, no urine was found in the bladder. She was then X-rayed in the kidney and ureteric region, when nothing abnormal was detected.

The blood-pressure was normal, the blood-urea 96 mgm. per 100 c.c., and no fresh symptoms had developed. No urine was passed and thus only 1 oz. was found in the bladder during the twenty-sixth, twenty-seventh, twenty-eighth and half the twenty-ninth days of the month.

It was decided to perform Cæsarean section, as the case was thought to be one of urinary obstruction and not a toxæmia of pregnancy.

At operation, a thirty-week baby, which only survived twelve hours, was removed. The right kidney was enlarged to one and a half times the normal size, and its pelvis and ureter both much distended, the latter down to 5 or 6 in. below the kidney, almost to the brim of the pelvis. The ureter was palpated below the dilatation, but nothing abnormal detected. The left kidney was felt to be considerably enlarged, but the left ureter was normal. It was decided to close the abdomen.

Six hours after Cæsarean section, as no urine had been passed, a cystoscopy was performed, and a No. 4 ureteric catheter passed up the right ureter for 4 in., when some obstruction was felt, and a No. 3 up the left ureter for its full length. The catheters were left *in situ*, but still no urine was passed for ten hours after the operation—the right-sided hydronephrosis apparently having maintained this condition of a reflex anuria for over eighty hours.

Next, a right-sided pyelotomy was performed and much urine drained away—the kidney being large and pale and difficult to deliver. At this stage the blood-urea was 112 mgm. per 100 c.c. On the second day (after the operation) the patient's general condition was fair, the œdema had gone, the blood-urea was 117 mgm., but yet no urine was passed by the bladder: the kidney wound was still draining well. On the third day the patient looked rather yellow and she complained of slight giddiness; the blood-urea was 110 mgm., the kidney wound was draining well, and no urine had been passed by the bladder.

By the fifth day the blood-urea gradually came down to 69 mgm., and on the seventh day following the operation the patient passed urine normally, containing 0·57 grm. of urea per cent. Thus the reflex anuria had lasted for upwards of eleven days—during the whole of which time only 1 oz. of urine was found in the bladder. The same day she had a syncopal attack, and the urea in the urine varied between 0·88, 1·10 and 1·02 grm. per cent.

On the eighth day her blood-urea went up to 161 mgm. per 100 c.c., and she complained of nausea, headache and pain in the loins. From that time, however, she gradually improved till on the twelfth day the blood-urea had come down to the normal, 30 mgm.

On the twenty-fourth day a cystoscopy was performed, and a cystitis found at the base of the bladder, with both ureteric orifices working well, the ureteric catheter passing well up the right ureter and no definite obstruction being found.

On the twenty-eighth day an X-ray photograph was taken, but no definite help was obtained. The patient now seemed quite well, and the urine normal. Six weeks later another X-ray photograph this time demonstrated a small triangular shadow in the line of the right ureter, just above its opening into the bladder. Three months after the Cæsarean section patient was re-admitted with a perinephric abscess, which was opened, drained freely, and healed up

well. This was then followed later by a laparotomy, and by the extraperitoneal route a ureteric calculus was removed from the pelvic part of the right ureter a short distance above the opening into the bladder. From this operation the patient made an uninterrupted recovery.

A few unusual features in this case consist in the length of time during which no urine was passed—the duration of the reflex anuria of the apparently healthy, though hypertrophied, left kidney even after the relief of the obstruction; the failure of the X-rays to help with the diagnosis of the obstruction, for which reason it was presumed possibly to be an inflammatory stricture aided by pressure of the pregnant uterus; the almost complete absence of symptoms; and, finally, the mobility of the obstruction when it was discovered.

I am very much indebted to Mr. J. B. Hume for his help and skill in the management of the urological side of this case.

Benign Polypi of the Vagina in Infants: a Report of Two Cases.

By Gilbert I. Strachan, M.D., F.R.C.S.

On account both of the rarity of this condition and of the fact that circumstances accidentally put two of these cases under the care of the writer within a few weeks of each other, it seemed that they were worthy of record.

Case I.—B. E., aged 18 months, was brought to my notice by Mr. Hammond, of the Surgical Unit, Welsh National School of Medicine. The child was well in every way, except that the mother had noticed spots of blood from time to time on the underclothing. Examination showed a firm, non-ulcerated polypoid mass about the size of a raspberry projecting from the vaginal orifice. It was semi-pedunculated and was attached by a narrow pedicle to the anterior vaginal wall about half an inch above the urethral orifice (fig. 1). There was slight bleeding on manipulation but no discomfort and no sign of infiltration at the vaginal attachment.

The vaginal orifice was dilated, and the tip of the little finger could be inserted behind the growth into the canal where the tiny cervix was felt.

On November 26, 1925, the growth was removed under anæsthesia. The pedicle was cut across and the base cauterized, although there was no bleeding of importance. Gauze was inserted into the vagina and removed in twenty-four hours. She was discharged from hospital on December 4, having made an uninterrupted recovery.

Case II.—A. H., aged 5 months, was transferred to my care by Mr. Berry Haycraft, also of the Surgical Unit. The history was that the mother had noticed a lump protruding from the "front passage" for four months. On examination a firm smooth mass about the size of a cherry was seen projecting through the vaginal orifice. It was attached by a fairly broad base to the anterior vaginal wall in about the same position as the other case, and again infiltration was absent.

On December 16, 1925, the tumour was removed by cutting across the base, cauterization and packing, and she was discharged from hospital on January 13, 1926, with the vaginal scar perfectly healed and the parts normal.

Examination.—The two polypi resembled one another in a number of ways, so that they can usefully be discussed together. The first specimen was lobulated and the second smooth, but both were about equal in size. The first was softer than the second, which was firm in consistency, and both were red and congested in appearance.

The cut surface showed a soft fibrous core in Case I, but in the second case there appeared to be a distinct, thick, fibrous capsule with softer material in the interior. In both cases the surface epithelium appeared to be intact.

Microscopically, the appearances were very similar in the two cases. On the surface was a definite intact layer of squamous epithelium varying in thickness in different places, here and there showing finger-like projections between the papillæ of the underlying stroma. In the second case (fig. 2) there was an underlying layer of loose stroma plentifully infiltrated with lymphocytes, and below this a broad layer of dense avascular fibrous tissue showing numerous cell nuclei, but no blood-vessels. This was not present in Case I, but in both cases the

interior and main mass of the tumour was composed of loose fibrous tissue of an embryonic type in which was seen a fair degree of infiltration with lymphocytes. Blood-vessels with well-formed walls were plentiful.

FIG. 1.—The condition of case No. 1 on clinical examination, showing the lobulated polypus projecting from the vaginal orifice.

FIG. 2.—Photomicrograph of specimen No. 2 showing: (*a*) intact covering squamous epithelium; (*b*) interior composed of loose embryonic connective tissue, and (*c*) well-formed blood-vessels.

These cases were admitted and operated on as being probably or possibly sarcomatous, but the microscopic characteristics as described, and especially the presence of intact squamous epithelium and of well-formed blood-vessels, would put this

diagnosis out of count and would indicate that the tumours were of the nature of simple papillomata.

Professor E. H. Kettle has kindly examined the sections for me, and his opinion is in agreement with that just stated.

The fact of both of these tumours arising from the same situation, in the anterior vaginal wall—incidentally the usual site of vaginal fibro-myomata—leads us to the difficult question of ætiology. It has to be confessed that no clear ideas have been formed in this matter beyond the causal probability of stimulation of some embryonic vestige in this region, and in this respect Mr. Christopher Martin, who saw Case II, has suggested the remains of the original vaginal septum as the seat of origin.

The rarity of the condition is worthy of note. The writer has searched through a large number of gynæcological and pathological text-books and periodicals and cannot find a record of any similar case.

A Revised Conception of Ante-partum Accidental Hæmorrhage.

By Gibbon Fitzgibbon, M.D., F.R.C.P.I.

(Master of the Rotunda Hospital, Dublin.)

In this paper I want to consider the nature and treatment of accidental hæmorrhage as a complication of pregnancy, and to express the opinion I have formed after six years' careful study and consideration of the cases met with during that time in the Rotunda Hospital. When I commenced my work as Master of the Rotunda Hospital, I looked upon and treated accidental hæmorrhage in accordance with the views generally accepted at the time. After two years I found I was no better able to estimate the severity of a case, and in several cases I had found conditions which could not be made to conform with the theories which I had accepted. It was about this time that I commenced carefully to study the disease. In this paper I wish to review my work during six years, to point out the characters in cases that appeared to me incompatible with the generally accepted views and to express the opinion I have now formed which I think is compatible with the characters of the disease and forms a basis for successful treatment. For this purpose it is necessary to define some of the points which I found incompatible with my clinical observations.

(1) Accidental hæmorrhage has been divided into two main types—revealed and concealed. The occurrence of these two types was explained by the fact that in the revealed type the uterine muscle was healthy, and therefore resisted distension by blood poured into the cavity of the uterus, whilst the concealed type was due to disease of the muscle, which made it irresponsive to stimulation and allowed it to distend passively. This fact I found to be absolutely inacceptable in view of the behaviour of the uterus in the vast majority of cases. Labour was the common outcome of these cases, and the labour was usually rapid, whilst the uterus acted perfectly both during and after delivery and quite irrespective of whether the case proved to be wholly revealed or was demonstrated after delivery to be a severe, concealed type by the expulsion of two or three pints of old clot from the uterus. If the collection of the clot in the uterus was due to disease of the muscle it was quite inconsistent with the action during and after labour.

(2) Although the fact is disputed to some extent, it is the more commonly accepted view that accidental hæmorrhage is due to toxæmia. I fully accept this view, but I found that although primiparæ suffer from the other toxæmic diseases twice as frequently as multiparæ, the latter supplied at least 85 per cent. of the accidental hæmorrhages, and more than half of the cases were advanced multiparæ.

(3) Of recent years it has been suggested that the toxæmia is the result of the extravasated blood and due to the re-absorption of by-products. This does not appear a tenable proposition in view of the many other conditions leading to extravasation of blood and without toxæmic symptoms, such as ruptured ectopic pregnancy and hæmatoma. A few cases have been described in support of this contention, but it seems to me that in these cases the apparent toxæmia or shock which is more commonly described, can be more reasonably accounted for by other factors. The occurrence of albumin in the urine in placenta prævia has been put forward in support of the contention that the toxæmia arises from extravasated blood, and a series of cases has been collected; but, in fact, it is an uncommon association, the percentage of placenta prævia cases with albumin being little, if any, greater than the percentage of albumin in pregnancy, whilst albumin with accidental hæmorrhage shows almost reciprocal figures.

(4) The results from various treatments are not consistent with the supposed condition of the uterine muscle, and here I wish to refer to the treatment accredited to the Rotunda Hospital, namely, "vaginal plugging." Tweedy advocated this treatment and expounded views as to how the bleeding was controlled by the plug. He demonstrated that a vaginal plug controlled the circulation in the uterine arteries, and that unquestionably bleeding did not continue after the plug was placed; but it has never been shown how the bleeding is stopped in view of the fact that the circulation through the ovarian arteries is not controlled. I think anyone who has done a hysterectomy at term will admit that the ovarian supply is as great as the uterine.

(5) Hysterectomy had been adopted as the treatment in a few cases, then Cæsarean section was substituted, and the uterus was found to act perfectly, although hysterectomy was adopted on account of the supposed degenerated state of the muscle. Neither operation appears to me to be justified by the results obtained, when compared with other treatments. Their aim is to control a hæmorrhage which cannot otherwise be controlled, but the specimens removed often showed no continuous bleeding and at Cæsarean section the uterus was usually found to contain no fresh blood.

I have gone through the records of the Rotunda Hospital for the nine years preceding my Mastership, 1910-11 to 1918-19. During this time plugging was the principal treatment adopted, Cæsarean section and hysterectomy were resorted to in some cases.

In the Hospital 51 cases are recorded with 8 deaths.
16 of these cases were treated by plugging, with 2 deaths
4 cases were treated by Cæsarean section, with 1 death
3 „ „ by hysterectomy, with 2 deaths
The remaining 28 „ „ palliatively, with 3 deaths.
In the Extern 33 „ are recorded, with 6 deaths.

Plugging was the only treatment adopted in the Extern, besides palliative measures, and of the patients that died four were plugged.

Thus from palliative treatment the mortality was 10·7 per cent.
„ plugging „ „ 12·5 „
„ Cæsarean section „ „ 25·0 „
„ hysterectomy „ „ 66·0 „

Assuming that plugging was resorted to with the same frequency in the Extern as in the Intern the results show that from palliative treatment the mortality was 9·1 per cent.; from plugging, 36·3 per cent.

There are some facts recorded of the Intern cases, especially those operated upon, to which I wish to draw attention. Of the fifty-one cases only seven were primiparæ; only one primipara died, ten days post partum; in one the membranes

were punctured, one with a macerated fœtus was plugged before being sent to hospital, otherwise six of the primiparæ required no treatment, having no symptoms other than slight external bleeding.

Forty-four patients were multiparæ and seven died; brief records are appended of typical cases.

Case I, 5-para. Admitted in good condition, no pain or distension, no bleeding. Pulse 100. Pulse rose to 140, 150; internal hæmorrhage diagnosed. Hysterectomy. Abdomen full of blood, the source of all of which could not be found. Died while abdomen was being closed.

Case II, 9-para. Admitted with pulse 150; uterus large, tense, painful. Hysterectomy. Parametric bleeding troublesome. Died in 10½ hours.

Case III, 4-para. Admitted, pale and weak, no external hæmorrhage; uterus normal, not tender. Membranes punctured, some blood came away. Spontaneous delivery in one hour, a gush of blood at birth. Uterus and vagina plugged. Died one hour later.

Case IV, 6-para. Admitted plugged, good condition, plug removed, no bleeding. Labour thought to be starting. Three hours later a little blood escaped; restless, pale. Hysterectomy. Parietes very pale, very little bleeding, blood watery. Recovery.

Case V, 9-para. Admitted pulseless and cyanosed. Placenta in lower segment. Version. Died undelivered. Much blood in uterus.

Case VI, 3-para. Pre-eclamptic state. Treated for seven days. Then slight external bleeding; uterus tense, tender; pulse 160 feeble. Cæsarean section. Intraperitoneal hæmorrhage, supposed to be from broad ligament. Left ovarian vessels tied. Recovery.

Case VII, 1-para. Admitted bleeding. Vaginal plug, removed in eight hours, spontaneous delivery. Died ten days post partum.

Case VIII, 3-para. Admitted blanched; uterus hard and tender. Improved before operation. Cæsarean section. Recovered. Note: Uterus dark, almost blue, with blood extravasations in patches. Peritoneum raised in blebs filled with blood, one had burst; blood in peritoneal cavity. On section, uterine wall showed blood extravasation all through. Uterus contracted well.

Case IX, 7-para. Admitted with abdomen tender and distended; pulse 130, Cæsarean section. Died in 1½ hours.

Case X, 5-para. Admitted in labour, external bleeding. Os three-quarters dilated. Membranes punctured. Pulse getting worse. Cervix divided, forceps. Died in 2 hours.

Case XI, 9-para. Admitted with albuminuria, concealed hæmorrhage. Cæsarean section. Free blood in peritoneal cavity. Uterus black in colour owing to extravasated blood. Recovery.

Case XII, 10-para. Twins. Admitted bleeding. Labour induced with tents. Patient had rigor, os full, membranes punctured. Delivery. Manual removal. Post-partum hæmorrhage. Died in 1 hour.

The points to which I wish to draw attention in these notes are in the cases treated by hysterectomy. Case I was of intraperitoneal hæmorrhage rather than intra-uterine, and there were no symptoms to indicate the condition until the patient had lost so much blood that she could not stand operation. Case II: Patient does not appear to have been controlled by the operation, if anything this made her bad condition worse. Case III: Patient was in good condition, seemed to be starting labour and at operation the bleeding was found to have ceased, the condition being only one of anæmia. In the cases treated by Cæsarean section, free intraperitoneal hæmorrhage was found in three, the uterus acted well, and Case VI was the only one in which some effort was made to control the supposed source of the free bleeding. The patient in Case IX died, but no active bleeding was found, the uterus acted poorly in just the manner to be expected in a depleted patient. The remaining five cases were treated by plugging and/or other form of interference. The 1-para died ten days after delivery, she was plugged but otherwise allowed to end spontaneously. One ended spontaneously but the uterus and vagina were plugged post partum. One was a low implantation of the placenta and possibly the retained blood collected after version. One was delivered rapidly after division of the cervix. The last case was complicated by post-partum hæmorrhage after induced labour.

Of particular importance is the description of the uterus in Cases VIII and IX, where it is described as blue or black with subperitoneal hæmorrhages and extravasations all through the walls. The condition of the uterine tissue is not described in any other cases, but the same condition is suggested in Cases I, II, and III, where there was broad ligament extravasation.

From a study of the above cases I do not think the claim is established that any case of accidental hæmorrhage is benefited by Cæsarean section, hysterectomy or other operative interference, that would not get well by careful expectant treatment. Further, there do not appear to be any definitely diagnostic symptoms by which the cases can be classified for treatment. It was owing to these conclusions that I abandoned operative treatment, including plugging, shortly after I was appointed in charge of the Rotunda.

I will now record my own statistics during the past six years and certain observations I have made.

During these six years in the Intern, there were 64 cases with 3 deaths.
„ „ in the Extern, there were 84 cases with 4 deaths.

During the first two years there were 13 cases with 1 death; of these 2 were plugged, with 1 death, as follows:—

Case E. T., 4-para.—Admitted in pre-eclamptic state, greatly improved until the fourth day, when profuse hæmorrhage with passage of clots occurred. Vagina plugged. Died in one hour. Uterus showed extravasations of blood in cornua and wall of uterus under placental site. No intraperitoneal bleeding.

Case M. R., 2-para.—Cæsarean section for contracted pelvis. Uterus found dark slate-blue in colour, large old blood-clot from cavity. After operation gave history of slight hæmorrhage, before admission there were no symptoms but urine was found loaded with albumin.

During the next two years there were 23 cases with 1 death. Three cases were plugged before admission, plug removed on admission.

Case M. L., 13-para.—Admitted in collapse, slight external bleeding. Improved during next few hours. Began to get worse, no further bleeding. Hysterectomy. Rather free bleeding under anæsthetic, not much from operation. Died nine hours after operation. Urine: marked albumin. Enormous quantity of blood-clot between membranes and uterine wall, outside placental area.

During the next two years there were 28 cases with 1 death.

Case L. O'G., 1-para.—Admitted with severe bleeding, pre-eclamptic. Very pale, uterus very tense and tender. Bleeding stopped on getting to bed. Patient semi-conscious. Membranes punctured. Improved. Delivered twenty-six hours later. Semi-coma deepened to coma during the following days. Died fifth day. Uterus well involuted. Hæmorrhages under peritoneum, in broad ligaments and extravasated all through uterine walls.

I would like to give the notes of one other case although it is not included in my numbers.

Case K. G. was in hospital on her second, third, and fourth pregnancies with eclampsia, each time complicated by severe ante-partum hæmorrhage. During the fifth and sixth days of one puerperium a pint of old black hæmatoma was collected, having been discharged through the bladder. In her fifth pregnancy the fœtus died at twenty weeks in spite of careful treatment, and I did a hysterectomy to terminate the pregnancy and prevent future pregnancies. The uterus was hardened and opened. Concealed hæmorrhage was found, the placenta was normally situated and perfectly attached to its site. The whole uterine wall showed extravasated blood in the tissues.

Now I want to compare these two series of cases. They are consecutive series, the first collected from the years 1911 to 1919, the second from 1920 to 1925. During the first period plugging of the vagina was the principal treatment, and hysterectomy or Cæsarean section began to be adopted. Eight cases were submitted to the latter treatment and three of these cases died. Of the cases not treated by operation five died. It may be claimed that the cases operated upon

were all very serious, but it must be equally admitted that amongst the forty-three cases not operated upon were a large number of quite as serious cases, and so the results from operation were not any better than from non-operative treatment. The trend of opinion at the time was that if the serious cases were operated upon earlier the results would have been better, but in looking over the notes of the cases it is difficult to see how a diagnosis and decision to operate could have been arrived at earlier in any case. Of course, if every case of accidental hæmorrhage was submitted at first sight to operation the results obtained would give a wonderfully good percentage result, but it would be an utterly fallacious justification of operation.

The second series of cases occurred during my mastership. At the beginning I was strongly inclined towards the operative treatment, but at the end of two years I was still absolutely unable to formulate any basis of selection. I had had a number of serious cases with only one death: that case would have been operated upon if it could have been done before death occurred. On the whole, my results had been extremely good—one death in thirteen cases from wholly palliative treatment; so that at the end of the two years I had fully decided to follow a strictly palliative line of treatment. Taking the whole second series there are three deaths. It may be contended that my series of cases included fewer serious cases than the first series. Such an argument can only be treated as absurd. The two series of cases are drawn during consecutive periods from exactly the same area of population. Of the cases in the second series, one was treated by hysterectomy—I was away from the hospital at the time. I doubt if I would have operated; nevertheless, the case was very serious, and the fact remains—the patient was not saved by operation. My third death occurred four days after delivery, with coma and complete anuria for four days. In the comparison of the whole results in the two series, it is better to avoid percentages. The cases may be looked upon as of the same type and severity.

1st series, 9 years.	33,000 confinements.	8 deaths for 9 years.		Unit 8
2nd „ 6 „	22,000 „	3 „	corrected to 9 years	„ 4½

I now record a number of facts about these cases. In considering symptoms and signs I shall only deal with the cases that were under my own observation, but with regard to the condition of the uterus I shall include the records from the first series.

There is a markedly greater incidence of the complication amongst multiparæ than primiparæ. In the Rotunda, out of 115 cases, ninety-nine were multiparæ and sixteen were primiparæ. I looked up the last four reports from Liverpool, Edinburgh, and Manchester, and found in 109 cases, ninety-three multiparæ and sixteen primiparæ. This is a very remarkable difference from what is found in eclampsia, where the relative figures are thirty to seventy. I fully accept the view that accidental hæmorrhage is largely due to a toxæmia, but with the above facts it must be a different toxæmia from that producing eclampsia, or there must be some factor existing in multiparæ, or produced by multiparity, which alters the effect of the toxæmia. To investigate this I have kept careful notes of the presence of albumin in the urine of my last forty-six cases. Six cases were primiparæ, and in five the urine boiled solid. In one case there was no albumin. Forty cases were multiparæ, in five the urine boiled solid, in twenty-one there was a marked amount of albumin, in eight there was only a slight trace, and in six there was "no albumin."

There seems to be a fairly close relation between the vitality of the fœtus and the degree of albuminuria, but there is no relation between these facts and the type of accidental hæmorrhage, whether revealed or concealed. There were seven cases with wholly concealed hæmorrhage, eight cases with wholly revealed hæmorrhage, and thirty-one cases with revealed hæmorrhage before delivery, but that showed a considerable quantity of retained blood-clot in the uterus after delivery: these cases I describe as combined hæmorrhages.

The following tabular statement shows the relation between albumin, life of the fœtus, type of hæmorrhage and the pre-eclamptic state—by the latter I mean albuminuria, œdema, drowsiness, &c.

6 primiparæ	...	5 urine boiled solid	...	3 pre-eclamptic combined	...	3	fœtus	dead
				1 concealed	...	1	,,	,,
				1 combined	...	1	,,	,,
		1 no albumin	...	1 revealed	...	1	,,	alive
40 multiparæ	...	5 urine boiled solid	...	1 pre-eclamptic concealed	...	Twins		,,
				3 pre-eclamptic combined	...	3	fœtus	dead
				1 concealed	...	1	,,	,,
		21 albumin marked	...	3 ,,	...	1	,,	alive
						2	,,	dead
				17 combined	...	2	,,	alive
						15	,,	dead
				1 revealed	...	1	,,	alive
		8 albumin slight trace	...	1 œdema revealed	...	1	,,	dead
				1 concealed	...	1	,,	,,
				4 combined	...	3	,,	alive
						1	,,	dead
				2 revealed	...	2	,,	alive
		6 no albumin	...	3 combined	...	3	,,	,,
				3 revealed	...	3	,,	,,

The above table shows that 3, or 50 per cent. of the primiparæ, had symptoms constituting the pre-eclamptic state, and in each case the fœtus was dead. Only one primipara was delivered of a living infant, and this patient was the only one with no albumin. The frequency with which the fœtus was dead is very much greater than that usually found with severe albuminuria or even eclampsia. In the past year, of eleven primiparæ with albuminuria, in which the urine boiled solid, only two were delivered of dead infants, and seven primiparæ with eclampsia, and a similar condition of the urine resulted in the birth of six living infants.

The multiparæ show a less degree of albuminuria, of five with urine that boiled solid, four showed the pre-eclamptic state, one of these was delivered of living twins; still, this is higher than the usual fœtal death-rate. In the past year seven multiparæ with urine that boiled solid resulted in the birth of only one dead infant. The table also shows that as the degree of albuminuria diminishes the number of living infants increases, but there is little or no difference between cases with urine that boiled solid and cases with marked albuminuria, the difference is between cases with severe albumin and those with only a slight trace or no albumin. The next table shows the relation between the type of hæmorrhage, whether concealed, combined, or revealed; the incidence of labour, whether started or not: the condition of the uterus at time of diagnosis, whether normal, tense, or tense and painful, and the result to the fœtus, whether alive or dead.

The patients considered to be in labour were, with two exceptions, delivered within fifteen hours, the average time being five hours. The two exceptions were completed in twenty-six hours. Those considered not in labour were delivered from two to eleven days after the onset of symptoms.

This table shows thirty-eight cases in labour; of these the uterus palpated normally in fifteen, three being with concealed hæmorrhage, seven with combined hæmorrhage, and five with revealed hæmorrhage. The uterus was tense in twelve

cases, one with concealed hæmorrhage, ten with combined hæmorrhage, and one with revealed hæmorrhage. The uterus was tense and painful on palpation in eleven cases, two with concealed hæmorrhage, and nine with combined hæmorrhage.

47 cases ...	7 concealed ...	6 in labour ...	3 normal ...	...	2 fœtus	alive
					1 „	dead
			1 tense ...	...	1 „	„
			2 tense and painful ...		2 „	„
		1 no labour ...	1 „ „	...	1 „	„
	31 combined ...	26 in „ ...	7 normal ...	...	6 „	alive
					1 „	dead
			10 tense ...	...	10 „	„
			9 tense and painful ...		9 „	„
		5 no labour ...	5 normal ...	...	2 „	alive
					3 „	dead
	9 revealed ...	6 in „ ...	5 „ ...	...	4 „	alive
					1 „	dead
			1 tense ...	...	1 „	„
		3 no labour ...	3 normal ...	...	3 „	alive

Of the nine cases not in labour, one, with concealed hæmorrhage, was tense and painful, all the others palpated normally.

In no instance was a living infant born in a case with either a tense or a tense and painful uterus. On the other hand, of the twenty-three cases with a uterus normal to palpation, seventeen infants were alive and only six dead. In the above two tables I have shown the result to the fœtus. I have done so because I think this is an excellent expression of the degree of placental ablation. That accidental hæmorrhage is largely due to ablation of the placenta is, I think, the commonly accepted view, but although I consider that extensive ablation very often occurs, I do not consider it the primary cause nor the important factor in the serious cases. The first table shows a relation between the presence of marked albuminuria and death of the fœtus, but very little relation between the death of the fœtus and the type of hæmorrhage when the albuminuria is marked. It also shows a lack of relation between the death of the fœtus and the type of hæmorrhage when albuminuria is slight or absent.

The second table shows a very close relation between the condition of the uterus and the condition of the fœtus irrespective of the type of hæmorrhage, and also between the condition of the uterus and the presence of labour, in conjunction with the condition of the fœtus and irrespective of the type of hæmorrhage. In this table there are two exceptions. One, a case of concealed hæmorrhage not in labour, with a tense and painful uterus and dead fœtus. This patient I did not see myself; she was very ill, improved for a while, then became worse and was treated by hysterectomy. I believe the deterioration was due to the onset of active labour, and that this would have been demonstrated if she had not been operated upon. I form that opinion from my experience of several other cases. The second exception is a case of revealed hæmorrhage, in labour, with a tense uterus but not tender; the patient was a very old multipara with a breech presentation and a very vigorous labour.

I now want to consider the condition of the uterus as recorded in those cases operated upon or submitted to autopsy. I have already recorded the observations in cases in the Rotunda; they conform with the observations of other operators. Williams, in the *Journal of Obstetrics and Gynæcology*, xxxii, No. 2, states that in all of the Cæsarean cases except one the uterus presented purplish-bluish discoloration. The extent of the hæmorrhagic infiltration varied greatly, sometimes involving the entire body, sometimes limited, in several instances extending beyond the uterus. He records that in each instance where the uterus was examined

histologically, intramuscular hæmorrhages were found about the periphery of small veins, more pronounced in the outer layers of the uterus. He was unable to find degenerative vascular changes, nor could he demonstrate degenerative changes in the individual muscle fibres. Bride, in the *British Medical Journal*, December 19, 1925, says :

"I have seen most of the cases and in all of them the uterus was sodden with blood, the broad ligaments were filled with blood, and there was free blood in the peritoneum."

My own observations conform with the above statements, and I have reproduced a photomicrograph which shows the condition very perfectly. I had sections from many parts of the uterus and all showed the same characteristics. The muscle fibres are separated, the interstitial tissue is invaded with blood. There are small and large areas of blood under the peritoneum, the uterine wall under the placental site is no more affected than other parts. Extravasations ran out on the broad ligaments, and the tubes were completely disorganized by blood extravasation. I have endeavoured to demonstrate degeneration of the actual muscle fibres in this case and two others, but could find no evidence of such.

Besides the operation and autopsy specimens I have been fortunate in seeing two other uteri in cases operated upon for other conditions. These cases, although accidental hæmorrhage was present, exhibited no symptoms.

In the first case, I did a Cæsarean section for contracted pelvis; the uterus was of a dark-blue slate colour, hæmatomata ran out on the broad ligaments. I opened through the lower segment and so did not see the sectioned surface of the worst looking part of the organ; the cut surface, where seen, looked like mildly bruised meat. The fœtus was alive and strong and the placenta was followed by a hard black clot the size of my fist. The placenta did not show evidence of ablation; there was no flattening of the maternal surface. After operation the urine was found to boil solid and the patient told me that just after labour began there was a gush of dark hæmorrhagic fluid from the vagina.

In the second case, I removed the uterus at twenty-two weeks' pregnancy with a dead fœtus. The patient had been in hospital for her three previous pregnancies and deliveries with eclampsia, each time complicated by severe accidental hæmorrhage; the infants were all dead, and she was suffering from chronic nephritis. The uterus contained concealed hæmorrhage, the placenta was normally attached, the whole uterine wall showed extravasated blood through the tissues.

The first case, I think, throws a great deal of light on the subject; if the patient had been capable of delivering herself through the vagina, I have no doubt she would have done so uneventfully and have been recorded as a mild case of combined hæmorrhage, without any suspicion that the uterus presented a pathological condition quite as severe as any of the recorded cases of accidental hæmorrhage.

One other case to which I will refer is very analogous to the case which forms the basis of Williams' paper referred to above.

The patient was admitted to hospital with low temperature and pulse, general debility and abdominal pain; fœtus alive, albumin *nil*. Kept under observation for five days and discharged very much better. Returned seventeen days later having had several fainting attacks in rapid succession, with peculiar twitchings, looking very bad, pale, temperature 97° F., pulse 105, blood-pressure 110, hemiplegia of face, arm, and leg, the uterus palpated normally and the fœtus was alive, albumin marked. Improved with application of warmth and drank fluid. Urine 18 oz. in twelve hours. Labour began ten hours after admission, the uterus became somewhat tense, and a profuse discharge of dark fluid blood appeared from the vagina with a few very black old clots. The membranes were punctured and delivery followed in three hours. The infant was alive but died in an hour. The birth of the fœtus and the placenta were followed by a very large quantity of hard, old black clots. The hemiplegia passed off gradually during the next week.

I now want to formulate the views I hold at present and as the result of my observations. I think that in the past few years, and as a result of operative treatment, we have discovered the true nature of the complication but we have confused

ourselves by trying to make recent observations fit in with our former incorrect theories. These are all based upon a wrong hypothesis—separation of the placenta.

There are two types of ante-partum accidental hæmorrhage: (1) a simple and truly accidental ablation of part of the placenta; (2) a toxæmic condition due to hæmatoma or apoplexy of the uterine wall, involving the placental site in common with the rest of the uterine wall but not originating in the placental site. The two conditions are totally unconnected and must be considered separately.

(1) Simple Accidental Ablation of the Placenta.

There are many distinct causes of the condition. (1) Low implantation of the placenta, so that it encroaches on the lower uterine segment; this is a not uncommon cause. The incidence is similar to that of placenta prævia, but as the placenta cannot be reached the cases cannot be diagnosed as prævia. The only symptom is external bleeding and the blood coagulates after collection in the vagina. The fœtus is not affected and the maternal health is good. There is usually persistence of bleeding in small quantity, or intermittently. This may lead to a progressive anæmia and require termination of the pregnancy. The pregnancy can be terminated safely by any of the recognized slow methods of induction of labour. As the ablation of the placenta is only likely to occur in these cases near term the infant is always alive and healthy. (2) Ablation of a normally situated placenta, an uncommon cause, but one which may occur any time in the last months of pregnancy. (3) Injury, such as falls or sudden violent muscle action of the abdominal muscles to prevent falls, may be the cause. The bleeding may be revealed, combined or concealed. When revealed it is usually sharp for a short time, then stops, and there is no tendency to return. The pregnancy continues unaffected. The bleeding may be wholly concealed, the blood lost collects under and near the placental site, is held up by the adherence of the membranes to the uterine wall. The blood coagulates and the bleeding stops. The coagulum contracts and the serum is expressed from the clot. The clot acts in the same manner as any foreign body introduced into the uterus to induce labour, and after a varying time the uterus takes on active contractions. The first effect of this is to extrude the serum down to the cervix, when it comes away in a sudden gush of blood-stained fluid which does not coagulate. In a multipara or a primipara with a relatively dilated cervix the clot may be extruded after the serum, and the stimulation being removed, labour may pass off and the pregnancy continue unaffected. The clot, when extruded, is firm, hard and dark in proportion to the length of time it has been retained. If the clot is not extruded early, labour may continue to delivery and the clot be retained until after the birth, owing to the presenting part filling the lower segment of the uterus. The patient does not show symptoms except the discharge of the serum, and the fœtus is alive, its condition depending upon the period of pregnancy. (4) During labour some condition may cause traction on the cord and this ablates the placenta. The bleeding is usually revealed and comes away as fluid blood or clots from the vagina; some blood coagulates in the uterus, being pent up by the presenting part, and the clots come away after and during birth; the bleeding may be severe, but seldom affects the patient too much before delivery is completed. The fœtus may die during labour; if not, it is healthy.

This type of accidental hæmorrhage may occur in a multipara or a primipara. The urine is free from albumin, but the condition may occur in a toxæmic patient with any degree of albuminuria; the association is wholly accidental.

I have had two cases definitely of the first variety, three cases of the second variety, one ended in delivery, whilst two expelled the clot and pregnancy continued. I have had two cases of the third type; in one the cord was round the neck and shoulder, and ruptured as the head was born over the perineum. The fœtus was alive, but died evidently from loss of blood. The other case was completed with forceps; the cord was very short and the fœtus was born dead.

(2) Toxæmic Ante-partum Hæmorrhage. Hæmatoma or Apoplexy of the Uterus.

In this type the condition of the uterus is that described in those cases submitted to laparotomy or found at autopsy.

Etiology.

Ninety per cent. of the patients are multiparæ, most of them advanced multiparæ. Out of the last thirty-five cases there were six 2-para, five 3-para, and the remaining twenty-four cases had an average parity of 8·5. The patients all had some albuminuria. During the same time there were six primiparæ, and five had albuminuria in which the urine boiled solid. Evidently the condition is something promoted by repeated child-bearing and associated with nephritis. I believe that in the multiparæ the cause is a chronic interstitial nephritis. I will quote Osler on this subject; he says:—

"Perhaps a majority of the cases are latent, and are not recognized until the occurrence of one of the serious or fatal complications." "The primary form is chronic from the outset and is a slow creeping degeneration of the kidney substance." "Microscopically there is seen a marked increase in the connective tissue and degeneration and atrophy of the secreting structures." "Even an advanced grade of contracted kidney may be compatible with great mental and bodily activity."

This is just what may be expected from the repeated strain of pregnancy. In the primiparous cases it is quite consistent to assume that there was a pre-existing chronic nephritis arising from previous disease. The kidneys of the primipara from whose uterus I have exhibited a photomicrograph showed definite chronic nephritis with numerous cysts all through their substance. The occurrence of pregnancy throws a culminating strain on the kidneys and results in a subacute exacerbation of the nephritis, as exhibited in some cases. The degeneration of the uterus is in the connective tissue between the muscle-fibres and is exactly comparable to the degeneration in other parts of the body in chronic nephritis, such as occur in the brain. This results in a slow but persistent extravasation of blood into the connective tissue and a concomitant oozing of blood into the uterine cavity. The degeneration occurs all over the uterus, under the peritoneum, and in the decidua, both at and outside the placental site. The progressive destruction of the placental site results in the slow death of the fœtus, and this commonly precedes the occurrence of symptoms by several days. The multiparæ are more definitely chronic cases and show a less degree of albuminuria and other symptoms of acute nephritis than the primiparæ, but the latter exhibit the same uterine changes. The ordinary toxæmia developed as a result of pregnancy and during it, culminating in eclampsia, produces symptoms of a more acute type of nephritis, and the pre-existence of a chronic nephritis accounts for those cases with little or no œdema, moderate albumin, and so often associated with accidental hæmorrhage. Accidental hæmorrhage developing in a 2- or 3-para is often the result of chronic nephritis persisting after a toxæmia in the first pregnancy. I can lay my hand on three cases with a history of eclampsia in a first pregnancy and accidental hæmorrhage in the second or third pregnancy. I have recorded a case, "K. G.," with eclampsia combined with accidental hæmorrhage in the second, third, and fourth pregnancies and accidental hæmorrhage in the fifth, each time occurring progressively earlier. Severe toxæmia without eclampsia, such as calls for termination of a pregnancy is, I believe, an even more potent cause of subsequent accidental hæmorrhage. These are the cases that develop accidental hæmorrhage in the second and third pregnancies and are impossible to carry on to a period of pregnancy when the fœtus is viable and still alive. I believe the fulminating cases of eclampsia are those occurring in patients the subject of a pre-existing chronic nephritis, and such cases may miss eclampsia and die of toxæmia or develop accidental hæmorrhage in their first pregnancies.

Symptoms.

The commonest symptom that brings a patient under notice is a sudden gush of external bleeding. If the discharge is looked at, it will invariably be found to be dark brown-red in colour and completely free from friable clots; occasionally there may be small black, shreddy clots. The urine will nearly always be found to be albuminous and often foggy; the secretion of urine is usually diminished. The patient may be in profound collapse or may be physically strong, or in any grade between these two conditions. A general debility and lassitude is very common. The face invariably exhibits a dusky pallor, or a muddy complexion. There is seldom much œdema, frequently none. The pulse-rate is either about 90 or over 120, the latter associated with the marked degrees of collapse. The uterus more commonly palpates normally, but may be tense, or tense and extremely sensitive; these characters do not always follow the degree of collapse. In the majority of the cases with a normally palpating uterus there is definite evidence of the onset of labour. In the tense and painful uterus this is difficult to estimate but subsequent events prove labour to have begun. The fœtal heart cannot be heard. In a small number of cases the uterus is tense, and/or painful, and the patient presents the above appearance but is in fair physical vigour and there is no external bleeding, or what is present is taken as "show" and the patient considers herself in labour. This state may be followed by profound collapse before the termination of delivery. A smaller number of cases present the toxæmic appearance and lassitude, the uterus palpates normally, and there is no fœtal heart. The case appears to be one of toxæmia with no suggestion of accidental hæmorrhage, or there may be profound collapse suggesting an internal hæmorrhage. Labour is not present. The patient may die rapidly, or, while being treated for toxæmia, suddenly exhibit external hæmorrhage or profound and fatal collapse.

There is one characteristic to which I draw special attention. When there is external bleeding the blood is always dark, as distinct from red, and it never coagulates. It is not whole blood but the hæmorrhagic serum expressed from coagulated blood, the coagula being retained in the uterus.

I will now explain these symptoms. The condition of the uterus is that described above, namely, hæmatoma through the muscle. There is extravasated blood in the uterus divided into serum and clot. The general symptoms are those of the chronic nephritis and consequent toxæmia. The muscle-fibres of the uterus are not affected and are quite healthy. There is no rapid bleeding at any time. As a result of the relatively foreign body collected in the uterus the majority of cases result in an induction of labour. If the apoplectic condition of the uterus is relatively mild labour sets in, the serum is expressed, and the uterus, although in most cases taking on a somewhat increased degree of tension above that of normal labour, does not present a degree of tension to call for notice. Labour terminates without undue alarm. When the hæmatomatous condition is more marked, the onset of labour results in an abnormal spasm of the uterine muscle, which presents noticeable increase of tension between the contractions, and in some cases produces continuous pain with marked tenderness on palpation. In those cases with subperitoneal extravasations this may cause pain independent of the uterine action. Some cases go on to an extreme degree of apoplexy of the uterus without coming into labour, or responding to the stimulation of the contained blood-clot, and may collapse from extravasation and loss of blood without the uterus responding.

The occurrence of collapse is dependent upon the depletion of the vascular system. The loss of blood is progressive over many days before any suggestion of the condition. As blood is lost the vasoconstrictor system is compensating for the depletion. The loss of blood may pass the capability of the vascular system to compensate, and then fainting of the system occurs, with a rapid loss of such compensation as had previously occurred. The patient rapidly passes from a condition

of relatively good strength into one on the verge of death. In the majority of cases compensation is maintained until the uterus responds to stimulation and comes into labour; again, in the majority it is retained until delivery is completed, but in some cases, not a small number, the strain of labour precipitates the collapse of the vaso-motor system, and the patient appears with external bleeding brought about by the activity of the uterus and at the same time in collapse.

The essential fact to be deduced from observation of the above is that the bleeding is never sudden or rapid; it has been going on slowly for many days. The collapse, when present, is not due to a sudden onset or increase of bleeding.

One other symptom needs explanation. The uterus is reputed suddenly to increase in size. This apparent increase is not real, but due to the increased and maintained projection forward of the fundus as the result of increased tension of the muscle. It is exactly similar to what is always seen at the beginning of a labour pain. In the normal uterus the muscle becomes flaccid between the pains, but in accidental hæmorrhage a degree of spasm is persistent.

Treatment.

During the past six years, but more especially during the past four years, I have based my treatment on the above views. I have given my results earlier in this paper.

If the fœtus is alive the patient is treated on purely palliative lines, and watched. If albumin is present she is watched with a little more care. The occasional cases of persistent fresh bleeding may call for induction of labour after several days. The others clear up or end in uneventful delivery. Those patients showing toxæmic symptoms ending in labour are allowed to complete delivery as a rule without interference, but if the uterus is tense or painful the membranes are punctured, the patient is kept warm with hot bottles and given water to drink freely. A patient showing debility or collapse is got to bed as rapidly as possible, given numerous hot bottles, interfered with as little as possible; if labour has started the membranes may be punctured at first and are usually punctured after a short rest. Fluid is given to drink, occasionally 10 to 20 oz. of bicarbonate are run into a vein at the end of one or two hours; I think it is important not to do this in too great a hurry, as the forced tension may delay spontaneous recovery of the vaso-constrictors. In profound collapse intravenous infusion is done at once; such a patient must be kept alive. Pituitrin in ½ or 1 c.c. dose is given in a very bad case but has little immediate effect; it is best administered after some evidence of recovery of the circulation. If the patient is in profound collapse and without evidence of labour the membranes are punctured and restoration aimed at. The puncture of the membranes results in the onset of labour and the termination of the pregnancy, when the patient is restored. If the condition of the patient is less severe, and after restoration labour is found not to have begun, it should be induced; this can usually be effected by mere puncture of the membranes, and the cervix is almost always dilated enough to allow this. The cervix usually admits two fingers, the only exceptions occur in primiparæ. No patient, no matter how she improves or what her condition was at the onset, is allowed to continue the pregnancy if the fœtus is dead. Labour is induced when she is well restored, by a slow process or by rupture of the membranes and sometimes the bringing down of a leg. Labour is always allowed to follow its own course; the fœtus is always small and the patient practically always multiparous, so there is no excuse for any form of extraction. I have never seen the least indication of post-partum hæmorrhage even in profound cases, but the uterus is always carefully controlled and stimulated by massage. Ergotine and pituitrin are often given immediately after delivery, to anticipate possible post-partum debility. The delivery of the placenta is usually followed by masses of old, hard, black clot which may be taken for active post-partum hæmorrhage, but the character of the clots should make the distinction quite evident. Post-partum hæmorrhage has been looked upon as a serious danger

in these cases; Bride refers to it. I have looked up the cases reported from Manchester with which he deals. There are six deaths, and these are the notes:—

(1) Membranes punctured, binder, spontaneous, P.P.H., hysterectomy, on fifth day general peritonitis. (2) Version and delivery, P.P.H. (3) Moribund, P.P.H., died undelivered (sic). (4) Rapid version, P.P.H. (5) Version, P.P.H. (6) Version, P.P.H., too collapsed for hysterectomy.

There is only one case not interfered with. I think most may be classed as *accouchement forcé*. There are no post-mortem notes; I believe rupture of the cervix would have been found as the source of bleeding in any in which it was active.

The assumed fact that the uterus is "rotten," and therefore incapable of contracting, is also given as a reason for fearing post-partum hæmorrhage. That this is not a fact has been demonstrated by Smyly, who performed Cæsarean section in two cases and found the uterus acted perfectly although presenting the characters described as "rotten." Jellett had one recovery and one death after Cæsarean section, the uterus not contracting properly. But the patient was moribund, and no muscle in such a patient can be expected to contract. I consider it is also past the capability to bleed.

Plugging of the Vagina.—This treatment was instituted in the Rotunda and is erroneously described as the routine in all cases; it was largely practised, sixteen times in fifty-one cases, with two deaths. I, personally, never could accept Tweedy's theory that it controlled bleeding by compressing the uterine arteries; that does not influence the ovarian supply. It appeared to yield results and at any rate was relatively harmless when carried out as taught in the Rotunda but admittedly was liable to increase shock. I believe the apparent results were due to its being applied to control a condition of bleeding that does not ever exist. The bleeding is a slow percolation, as I have explained. I have never adopted plugging and now have completely given it up.

Cæsarean Section.—This is the last method of treatment to which I will refer. It is being advocated in the present day by high authorities, and I consider on totally wrong bases, of a rapid and persistent bleeding that must be stopped.

A patient in profound collapse is not in a condition to stand a laparotomy or even the inevitable disturbance preliminary to operation. Results from Cæsarean hysterectomy are worse than from any other form of treatment—even *accouchement forcé* by version or forceps. The operation is defended on account of the condition of the uterus found at the time, and it is stated that those patients who recovered were saved and would otherwise have died. My answer to this is that in my results, in a series of sixty-four consecutive cases, there were three deaths. One death was after hysterectomy; I did not see that patient and I do not say she would have lived without operation, but she could only have died. I quite admit that the cases operated upon were all serious and the more patients operated upon the better the statistics will be, but every case operated upon is taken from those treated by palliative measures, and those given in the statistics from Manchester, compiled by Bride, show four deaths out of 198 cases with either no treatment, or with only rupture of the membranes or plugging. The present claims for Cæsarean section in accidental hæmorrhage are, I consider, comparable to the claims for that operation and other modes of rapid delivery that were adhered to for twenty years in the treatment of eclampsia, in spite of a mortality of over 30 per cent. and in opposition to the palliative treatment advocated by the Rotunda, the adoption of which during the past five years had reduced the mortality to under 15 per cent. in those places where the conservative treatment of eclampsia is now followed.

In conclusion, I wish to ask the profession seriously to consider the views I have propounded. The summary of these views is, that ante-partum accidental hæmorrhage is the culmination of a slowly-developed condition of the uterus due to chronic nephritis; it is never at any time a rapid bleeding and treatment should be confined

to restoring the collapsed circulation, keeping the patient alive and then terminating the pregnancy by the simplest means, which is by the natural forces, and if allowed to occur will be completed spontaneously and rapidly in the great majority of cases, after recovery from the collapse. A patient who is incapable of recovering from the collapse is far less capable of standing a hysterectomy.

Discussion.—Dr. D. J. MALAN said that he had looked up the records of thirty cases of accidental ante-partum hæmorrhage, and the results of treatment in these made him unwilling to accept the statement that the only treatment required was palliative and expectant, and that operative interference was uncalled for and dangerous. How did Dr. Fitzgibbon stop the bleeding when it continued in spite of palliative treatment? That in cases of concealed accidental hæmorrhage the uterine muscle acted well was also contrary to his experience. In three cases in which Cæsarean section was performed two required subtotal hysterectomy, as the uterine muscle refused to contract properly. In the third case the uterus was preserved only after prolonged efforts had been made to make it behave properly. Two of the three patients survived, and the last-mentioned patient six years later gave birth to a 9½ lb. baby, with normal pregnancy and normal labour. If chronic nephritis is the causal agent then the hæmorrhage should recur in subsequent pregnancies. This was not his (the speaker's) experience, and he found it difficult to accept without further proof the explanation of Dr. Fitzgibbon regarding the cause of accidental ante-partum hæmorrhage.

Dr. R. H. PARAMORE (Rugby) referred to two cases of serious accidental hæmorrhage under his care. In the one the membranes were ruptured, a great rush of blood occurred and the patient immediately died. In the other, admitted as a case of placenta prævia with a dead child, Cæsarean section saved both mother and child.

He was surprised to hear that Dr. Fitzgibbon denied that the uterine muscle was necrosed or degenerated in these cases, in view of the work done by the late Gordon Ley. He (the speaker) was under the impression that lesions of the uterine wall, and especially its hæmorrhagic state, only occurred or were most marked in cases of concealed hæmorrhage of magnitude. He reminded the author that absence of histological signs of cellular degeneration or necrosis was not evidence of functional activity.

Dr. Fitzgibbon divided cases of accidental hæmorrhage into two types: (1) Simple, and (2) toxæmic, the toxæmia being due to chronic nephritis. But Dr. Fitzgibbon apparently thought that the severe cases, the cases in which hæmorrhagic extravasation into the uterine wall and broad ligaments occurred, were always toxæmic; and that the simple cases, e.g., due to trauma, did not produce this state. But his evidence was inconclusive. In the simple cases there was either no albuminuria, or if there was Dr. Fitzgibbon regarded it as a concomitant unassociated with the bleeding. He (Dr. Paramore) believed the albuminuria in the traumatic cases was at times the result of the distension of the uterus which the bleeding caused. But to understand how accidental hæmorrhage occurred, a study of the dynamics of the capillary circulation—and the placental sinuses were but modified capillaries—was necessary.

Mr. L. C. RIVETT agreed emphatically that there was more than one type of accidental hæmorrhage, and that the so-called "toxæmic" type was a definite entity. He called attention to the fact that in many cases the amount of blood lost was not sufficient to account for the severity of the symptoms. He asked whether the condition of the kidney in fatal cases was in keeping with chronic nephritis, and also, whether patients who had lived subsequently showed clinical signs of this disease.

Dr. FITZGIBBON (in reply) said that the kidneys in one of his fatal cases showed definite chronic nephritis, in his other fatal cases the kidneys were not examined; of his cases that recovered, several remained chronic invalids and were transferred to general hospitals, where one died nine months later. The case recorded "K. G." was an excellent illustration of the progressive permanent damage to the kidneys. As to subsequent pregnancies, in the severe cases they tended to terminate at earlier periods as abortions and miscarriages, and markedly resisted efforts to carry on the pregnancy—he had carried out hysterectomy in the case of two patients to stop this recurrent, useless conception. Dr. Malan asked how the bleeding was to be stopped to allow recovery; in reply to this question the contention of the paper was that the bleeding was never rapid and did not require treatment. Dr. Paramore considered that the muscle was degenerated, but this had never been demonstrated histologically. Dr. Paramore asked whether it was possible to distinguish the two types of cases; he (Dr. Fitzgibbon) thought it was and indicated the characteristic symptoms; but the accidental

association of ablation of the placenta with an ordinary toxæmia of pregnancy might occur and become misleading. In the majority of cases operated upon, the peritoneal cavity was free from blood. He (Dr. Fitzgibbon) hardly expected the suggestion of hæmatosis of the uterus to be accepted at once, but he was very pleased to know that the President was inspired to look into the question.

A Plea for Drastic Reform in the Teaching of Midwifery.

By G. W. Theobald, M.D.

There is a growing consciousness, which is not confined to medical circles, that the state of midwifery in this country is not what it should be. The official statistics are dreadful. Four women out of every 1,000 who give birth to children die through childbirth. That is to say that, assuming that a mother has four children, she undergoes a total risk of very little less than 1 in 250 of dying as a result of childbirth. Such figures are terrible, but they only represent a fraction of the truth.

Of the 3,000 mothers who die annually in England and Wales, over 1,000 die from sepsis. If 1,000 die, there is little doubt that a great many more are severely infected and barely escape with their lives. There is reason to believe that the actual number who die is greater than recorded, as these women who succumb within a short period of childbirth and are registered as dying from pneumonia should really be included in the deaths from sepsis.

A large number of the gynæcological operations, including most of the ectopic gestations, with the risk to life and the long period of disability involved, are made necessary by bad midwifery.

A far greater number of women suffer ill-health and varying degrees of inconvenience, often amounting to pain, all their lives, but either cannot bring themselves to face the ordeal of a gynæcological examination, or consider that such discomfort is the heritage of all mothers. The numbers of these sufferers is enormous.

Finally, we may consider the sum-total of misery, the broken homes, the orphans, the widowers. What more need be said to prove that the cold figures of the Registrar-General only give a very faint idea of the ghastly results of childbirth in England and Wales?

In order to improve matters various steps have been taken. The midwives have been registered. Ante-natal clinics have been formed in a large number of centres. There has been an alarming increase, more far-reaching than is realized, in the State control of midwifery. A vast amount of money and effort have been expended and there is very little cause for congratulation. In fact, the figures do not show that amount of improvement that could reasonably have been expected, even if such efforts had not been made. There is indeed reason to believe that further improvement is not likely, but rather a deterioration may be anticipated in the future. The midwife is expected to know too much, and a midwife who knows too much is a danger to the community.

A highly educated and trained sister in the operating theatres of our great hospitals would not dream of opening a superficial abscess, and yet a woman with less advantages in surgical and other training is expected to make a vaginal examination, to deliver breech presentations, and in what she considers an emergency remove a placenta.

The doctor is getting less experience in normal midwifery, and will not be so good at abnormal work as the old practitioner, who learned his obstetrics after he qualified by being an assistant in a large midwifery practice. Lastly, the ante-natal clinics, with all their potentialities for good, may in fact be a source of danger, for they have made possible an enormous amount of meddlesome operative midwifery.

There is one solution to the problem which has not been given a fair trial, and that is an improvement in the teaching of midwifery. I am convinced that radical and obvious changes in the teaching of midwifery would be of more value than all the other efforts put together, in reducing maternal injuries and mortality, and far less expensive.

I propose giving you some idea of the way in which obstetrics is being practised, by supplying a short résumé of some of the cases admitted to the Leeds Maternity Hospital during 1925. Practically all the cases were admitted, treated and recorded by myself.

1493.—Primipara, aged 25. Labour said to have started five days before admission—in which time she had about five minutes' sleep. Unsuccessful effort at delivery with forceps. Patient admitted to hospital, worn out, the head high and the external os only one-quarter dilated. Morphia and scopolamine were given and the head later came down and was lifted over the perineum with forceps. Vagina torn to ribbons. Doctor thought that he "was pulling bone against bone damned hard," and he was. 10 S.W.G. Not morbid.

755.—11-para, aged 42. Changed a face-presentation to vertex—and tried to deliver head with forceps. Head was high above brim, and the obstruction was caused by the placenta.

1028.—3-para, aged 31. Doctor applied the forceps for an hour or so—and then sent for another doctor. Attempts at delivery were made lasting for five hours. The woman was ultimately brought into hospital. The forceps were applied and delivery was fairly easy. The vagina was torn to ribbons. The patient had a severe parametritis and was in hospital for eight weeks, her temperature going up to 104° F., and went out a physical wreck.

525.—1-para, aged 33. In labour twenty-four hours. Head above brim. One doctor put on forceps and pulled hard. He then sent for another doctor who pulled hard. The patient came into hospital in a seriously collapsed condition and with the head high. She was given some scopolamine and later some morphia, and the head came down to the perineum and was lifted over with forceps. The vagina was torn to ribbons. The mother ultimately recovered and the child did well.

494.—1-para, aged 35. Primary uterine inertia. No sleep for five days—frequent vaginal examinations. On admission the head was not engaged by its greatest diameter. Morphia. Scopolamine. Quinine. Forceps. Walcher's position. Female child, 7 lb. 10 oz., did well.

191.—1-para, aged 27. The forceps were applied one evening, but after long efforts at delivery had failed, the woman was left. Next morning the forceps were again applied, but in vain, and so the woman was admitted to hospital! A baby, weighing 8 lb. 14 oz., was delivered by the forceps, and did well (forceps in middle strait).

655.—1-para, aged 21. Brought in by the doctor in his own car for immediate Cæsarean section. The head was well engaged. An injection of morphia and scopolamine was given. A living baby weighing 7 lb. 8 oz. was born in six hours.

1262.—2-para, aged 31. Doctor came to the hospital to see a Cæsarean section, but the baby was born spontaneously soon after the mother was admitted.

1167.—3-para, aged 29. Sent in as a case of obstructed labour, after prolonged efforts at delivery with the forceps, and still under the anæsthetic. An enema was given and a catheter was passed, and a child weighing 7 lb. 10 oz. was born in twelve hours.

1456.—1-para, aged 20. Membranes ruptured twelve hours before admission. Doctor tried to dilate up cervix nine hours after the membranes ruptured, while the patient was under an anæsthetic, but failed and sent her into hospital as a transverse presentation. By abdominal examination it was found that the head was engaged, and no further examination was necessary. An injection of morphia and scopolamine was given, and an enema. The patient delivered herself of a female child weighing 4 lb. (Pelvic measurements, 10 in., 10¼ in., 7¼ in.). Temperature 102·4° F. Pulse 106 before delivery, normal after. Two doses of A.S.S. 40 c.c.

1074.—1-para, aged 20. Sent in as a transverse lie. Head engaged by abdominal palpation. Scopolamine $\frac{1}{150}$ gr. Female child, weighing 6 lb. 12 oz., was born in five hours and did well.

1459.—1-para, aged 26. Forceps were tried on two separate occasions. On admission, head just engaged, cervix only half dilated. Scopolamine $\frac{1}{150}$ gr. Head came down on to the perineum and was lifted over with the forceps. Baby had been dead for some hours. "I have three pairs of forceps, and I used two different pairs, and I pulled damned hard and could not shift the head."

1388.—1-para, aged 27. Patient sent in as a case of obstructed labour. There was a large mass of fæces in the colon. Enema, morphia. Two doses of scopolamine. Two doses of pituitrin. Head came down on to the perineum, and was lifted over with the forceps. Female child, weighing 6 lb. 14 oz., did well.

1414.—1-para, aged 25. In labour for twenty-four hours before admission. Seven vaginal examinations were made outside. On admission, the external os was only one finger dilated, but the head was well engaged. Morphia. Two injections of scopolamine. Quinine 10 gr. The head came down to the outlet, and a male child, weighing 6 lb. 2 oz., was delivered with the forceps and did well.

1038.—1-para, aged 30. Forceps slipped twice. Two vaginal examinations by midwife. Easy delivery with the forceps. Free bleeding from vaginal tear which extended to the fornix. Male child, weighing 6 lb. 13 oz., did well.

1062.—1-para, aged 27. In strong labour for forty-eight hours. Numerous vaginal examinations by midwife. Head high above the brim. True conjugate 2½ in. and perforation, death from sepsis on nineteenth day. Temperature 102·8° F. Pulse 120 on first evening.

297.—1-para, aged 24. Membranes ruptured six days. Labour commenced twenty-four hours before admission. Doctors out all morning and afternoon. Several anæsthetics. Cervix manually dilated. Patient sent in as a case of impacted shoulder. On admission temperature 100° F. Pulse 140. Very shocked. A case of hydrocephalus. Died from sepsis after fighting for her life for eight weeks. Temperature started first day.

296.—1-para, aged 32. Patient was three hours under an anæsthetic while two doctors tried at intervals to deliver with the forceps. Head high. Pelvic measurements 8½ in., 9½ in., 7 in. Perforation. Mother not morbid. "If only I had had a pair of forceps that were long enough and strong enough I would not have brought her in here. My wretched things kept bending."

1203.—1-para, aged 24. In labour twenty-four hours. Membranes deliberately ruptured by midwife. Innumerable vaginal examinations. Double pneumonia. Empyema. Patient just escaped with her life.

479.—1-para, aged 35. In labour thirty hours. Attempts at forceps delivery for two hours. Cervix only quarter dilated. Head high above brim. Perforation.

876.—1-para, aged 20. In labour twenty-four hours. Three vaginal examinations by midwife. Hydrocephalus perforation.

746. 3-para, aged 30. Contracted pelvis. In labour twenty-four hours. Unsuccessful forceps outside. Head above brim. Version. Living child, which did well.

428.—3-para, aged 26. In labour twenty-four hours. Numerous vaginal examinations. Sent in as a breech. Was a case of prolapsed arm and cord, and a living child weighing 7 lb. was delivered as a breech, after an internal version had been performed.

218.—4-para, aged 35. The doctor had discovered a prolapsed cord. He therefore attempted to deliver with the forceps and failed. He sent for another doctor who also failed. The woman was sent into hospital late at night as an urgent case, but the baby was born in the taxicab.

A case of hydrocephalus. The doctor pulled with the forceps for hours. They slipped off on many occasions. Skull was perforated without any anæsthetic, and the body was easily led out with Brillet forceps.

Miscarriage.—6-para, aged 27. Arm pulled off and patient sent to hospital, where she delivered herself spontaneously.

582.—7 para, aged 35. Placenta prævia. Plugged with two lumps of cotton wool the day before admission.

892. 5-para, aged 38. Placenta prævia. Marginal. Awoke in pool of blood two days before admission. Nurse told her there was nothing to do and that she had better get on with her work. Temperature 99·2° F. Pulse 112 on admission.

7-para, aged 27. Placenta prævia. Twenty-six weeks X. Very collapsed and anæmic. Had been plugged by doctor two days before admission—but she had coughed out the plug almost at once. I requested the doctor not to plug again before sending her in—as he had suggested.

59.—3-para, aged 36. Ante-partum hæmorrhage for twenty-four hours. She was told that she was a very rare case with her "heart in her bowels." Very ill and collapsed on admission.

1256.—11-para, aged 42. Toxæmic. Ante-partum hæmorrhage. Alb. xxx. Numerous vaginal examinations by doctor and midwife before admission.

11-para, aged 40. Incomplete abortion. Temperature normal. Pulse 92. Three tampons in vagina. Bleeding for two days. One tampon in vagina. Accidental hæmorrhage. Alb. xxx.

8-para, aged 23. Miscarriage five days before admission. Frequent attempts at removal of placenta. Finally sent to hospital with the placenta still retained and died within twelve hours of her admission.

1140.—2-para, aged 37. Placenta prævia centralis (term). Began to bleed six days before admission. Seven vaginal examinations. Acute sepsis. Mors.

157.—4-para, aged 39. Central placenta prævia. Vagina plugged with 36 in. of gauze.

Many cases of toxæmia were kept unrecognized for days before being sent into hospital. One patient—booked as in-patient for delivery—was kept at home for fifteen days because she was too ill to be moved. She then came into hospital to die in a few hours. At least nine women died during the year as a direct result of sheer bad midwifery.

It is obvious that for every one case admitted to the hospital after unsuccessful attempts at forceps delivery there were several women whose children were dragged from them, dead or alive, through half-dilated cervices.

Nearly every case sent in by a doctor had previously been vaginally examined on several occasions by the midwife.

There can be no shadow of doubt that the doctors and midwives were directly responsible for those and many other similar cases that occurred in Leeds. There is also no reason to believe that the state of affairs in Leeds is any better or any worse than it is in any other industrial centre.

In my opinion the teaching authorities are, if anything, more responsible for the bad midwifery than are the units who actually misapply the forceps. The truth of this contention was very forcibly borne in upon me by the following experience. One of the above-mentioned cases was admitted with the head high and the cervix one-half dilated. The doctor who had sent her in telephoned to me that evening to know what had been done. I explained that I had given some scopolamine as the cervix was not yet fully dilated. He got rather annoyed with me, and said that he was a strong man and had pulled hard, and that he was certain that the head could not come down. The head did come down to the perineum. I unwisely wrote inside the chart: "The second case of damnable midwifery of the meddlesome type that has been admitted in the last two days." The doctor visited his patient and read the chart, and asked if he could see me. He was exceedingly nice and said frankly that he did not know anything about midwifery. He had qualified in the last three years, and had had no clinical instruction in midwifery. The patient made a great deal of noise and he felt he ought to do something. He was amazed to hear that the head came down, and promised never again to apply the forceps until the cervix was fully dilated. I have discussed this subject with many doctors, and they all admitted that they had to learn whatever midwifery they knew at the expense of their patients.

There is one other important consideration. Many practitioners, rightly or wrongly, are very unwilling to send patients into hospital, as they consider that they know as much about midwifery as do the members of the hospital staff, who are themselves very often engaged in general practice.

Looking at the matter from another angle, how is it possible for the doctors to know anything about the subject? The students attend large numbers of lectures, which may or may not be more valuable than reading books. They may even get a certain amount of bedside teaching—so-called clinical instruction. They do not, however, receive the one thing that is necessary. It is of no use to tell a man in a lecture that he should not apply the forceps until the cervix is fully dilated. It is necessary for a man to be very sure of himself to refuse to apply the forceps in the face of pressure from the husband and relations after a woman has been in labour for some hours. He wants to do something—he is expected to do something

—and he is not sufficiently experienced and confident to exercise masterly inactivity, that virtue which is of great price. He must be shown, while a student, how such cases are treated. A person living in, or close to the hospital, should demonstrate the treatment of such cases at frequent intervals, and the fact that the woman can in 95 per cent. of cases deliver herself. He should be taught the use of such drugs as scopolamine and morphia. He should learn that 95 per cent. of cases in labour can be conducted by inspection, together with Pawlik's grip.

The resident medical officer is, in most cases, far too inexperienced to conduct this teaching. He is, in fact, in many cases, afraid of the labour ward sister, and realizes that she knows more about normal midwifery than he does. It is no exaggeration to state that a man only begins to realize that he knows nothing about midwifery after he has lived for a year in a maternity hospital. Here is the crux of the matter, and it is in the solution of this problem that the hope for the improvement of midwifery lies. It is the present hospital system that is responsible for the bad midwifery in this country, not the Universities, not the specialists, not the practitioners, and not the midwives.

The hospital system of this country evolved in its present form when medicine and surgery were the only two subjects worthy of consideration. An attempt has been made to graft the new plant of obstetrics into the old stem, and it is a failure. It is possible for a surgeon to say, "I will operate at such and such a time to-morrow," or for the physician to do his rounds at a stated time. The surgical and medical conditions persist for some hours if not days, and the student is thus able to learn all that is possible about the diagnosis and treatment of the conditions from those best able to teach. It is not possible for the obstetrician to say, "I will apply the forceps at 11 o'clock to-morrow," or "I will do a version for placenta prævia to-night." The conditions in midwifery are all emergencies, and the teacher and his student must reside in or close to the hospital. This fundamental difference between obstetrics and surgery or medicine has not been sufficiently appreciated.

Until there are several combined gynæcological and maternity hospitals in the country—where men can stay and learn midwifery and gynæcology under some teacher, for at least three years, improvement cannot be anticipated. The hospitals must be combined, for no man can afford to stay three years doing nothing but midwifery, and then start to learn gynæcology.

The following is a short account of the Rotunda Hospital: it is managed by a Master who holds his appointment for seven years, and two Assistant Masters who hold their appointments for three years. The extern department is managed by two extern assistants who are responsible to the Assistant Masters, and give the anæsthetics in the hospital. No man can be appointed as extern assistant until he has done a six months' course in midwifery—either as a student or post-graduate. No man can be appointed as Assistant Master until he has been extern assistant. No man can be appointed as Master unless he has been an Assistant Master.

The Assistant Master does one month's work on the maternity side and the next month's work on the gynæcological side. All the work in the hospital is done either by the Master or his assistants. All the records are carefully kept by the assistants, who actually do the operations.

If the results in the treatment of placenta prævia are better in Dublin than anywhere else it is not because the Irish women are hardier than others, but because it is not considered justifiable to leave the treatment of such a dangerous condition to a person with very little experience, any more than it is right to leave the treatment of a perforated gastric ulcer to a house surgeon.

If there are less Cæsarean sections in the Rotunda Hospital, and less cases in which labour is induced, it is because those who treat the cases live in the hospital and do not decide in a hurry what treatment to adopt. They are content to watch the process of labour at frequent intervals. In an illuminating address on the

"Renaissance of Midwifery," Dr. Herbert Spencer stated that Baer, the founder of the great Viennese school, studied with Smellie and Hunter, and adopted the British practice, "having learnt in France what art, in England what nature, could do."

I am afraid that in many centres in England to-day nature is not having much of a chance. The fact remains that the Rotunda always has from twenty to fifty students and post-graduate students from all over the Empire and America in residence. I remember an American who went to London with letters of introduction from leading surgeons in America to two of the best known obstetricians in England. They said to him, "If you have come to learn midwifery, get out of England and go to the Rotunda."

Imitation may be the sincerest form of flattery, but it is equally true that a great man is not ashamed of recognizing greatness in others, nor of adopting and trying to improve upon a system which he thinks is better than his own. The system of a large number of honorary officers on the staff of one hospital makes it impossible for a definite and consistent line of treatment to be carried out for any reasonable period of time.

It is, moreover, almost impossible for the staff thoroughly to supervise the nursing and internal management of the hospital. The result is that arrangements which should be under the control of the obstetricians pass into the control of the matron and nursing staff. I am convinced that a low maternal morbidity rate can only be obtained if a thoroughly well trained and competent doctor lives in the hospital, and makes it his business to supervise every detail of the routine (such as the cleansing of bedpans and douche pans, &c., and the methods adopted for normal deliveries and normal vaginal "wash-ups").

The students in England very often deliver fewer cases than the nurses, and are taught by people who have had very little opportunity of learning conservative midwifery. I, myself, know many friends with little or no experience of practical midwifery, who have been appointed to the staffs of maternity hospitals. It is impossible to learn midwifery through being appointed to the staff of a hospital. The result is a perfect orgy of Cæsarean sections. The reports of the maternity hospitals offer testimony of these facts. Worse than that—if a man through obtaining a surgical qualification is appointed gynæcologist to some hospital, he becomes *ipso facto* an obstetrician. A cynic could say hard things, considering that a great part of the work of a gynæcologist is to repair the effects of bad midwifery. I plead, therefore, that there should be three or four improved Rotunda hospitals in England, not merely maternity hospitals, but schools of midwifery, where students can reside and learn practical conservative obstetrics by a process of osmosis. The future doctors will then learn not to interfere with normal labour, and to send abnormal cases into some institution where there will be somebody fully qualified to treat the abnormality. It is surely reasonable to claim that no operation, other than low forceps, should be carried out in a private house. In the Leeds Maternity Hospital out of 1,505 deliveries, including a large number of cases sent in from outside, the forceps were only applied on fifty occasions, and in all but seventeen cases the head was at the outlet.

The training of midwives also needs changing. I would suggest that they should be forbidden ever—under any circumstances—to make a vaginal examination. If the case is normal no vaginal examination is necessary. If the case is abnormal a vaginal examination is strongly contra-indicated.

The midwife can find out whether the head is engaged by abdominal palpation. If the patient is bleeding the case is obviously abnormal. If it is desired to find what is the dilatation of the cervix this can be done with ease by rectal examination. In a book recently published rectal examinations were condemned on three grounds:—

(1) The gloves cannot be sterilized after such an examination.

(2) There is a risk of damaging the walls of the rectum.

(3) Nothing can be made out.

The first two reasons need not be discussed. The third is equally inacceptable. In the Leeds Maternity Hospital all the cases were conducted by rectal examinations. After the nurses had carried out their prescribed vaginal examinations they made rectal examinations; so also did the students. I claim that it is almost as easy for a nurse to find out all that she wants *per rectum*, as it is for her to do so *per vaginam*. No emergency case was admitted during the year which had not been examined vaginally on many occasions before the doctor was called.

Nurses are expected to be acquainted with a great deal of theory, and are forced in examinations to say that they would do all sorts of operations in an emergency. I know one nurse who was driven to say that she would remove a placenta manually, and then plug the uterus, using a poker! She passed first of all the candidates.

The fundus was not controlled during the third stage of labour in any case in the Leeds Maternity Hospital during the year 1925. Only two placentæ needed to be removed manually. No cases of post-partum hæmorrhage required any intra-uterine douche or manipulation. If the midwife practises in a very lonely spot I would suggest that she should receive a special licence to remove the placenta if necessary. I would, however, claim that it is a very unwise thing to give uneducated women the right to remove a placenta, to carry out an operation for which they are not trained, and an operation which is by no means easy, is rarely indicated and is always risky.

Sepsis.

I have the temerity to suggest that it is an unfortunate fact that the British Medical Association Committee who have drawn up the interim report on the "Causation of Puerperal Morbidity and Mortality," have suggested that further progress in the knowledge of puerperal sepsis is most likely to be made by the study of the endogenous causation of infection. They refer to the exceedingly interesting and instructive paper read by Fitzgibbon and Bigger before the Obstetrical Congress in London. I have only two observations to make: (1) Every case investigated was vaginally examined on at least two occasions by a nurse. (2) I do not believe it is possible, by any device as yet evolved, to obtain a culture from the uterus that is free from cervical contamination.

I have been trying in vain to discover an authentic case of fatal sepsis that occurred in a woman who had never been vaginally examined. I certainly have never seen such a case. It must be remembered that some methods of normal delivery amount to a prolonged vaginal examination. There is not the least doubt that the great majority of morbid cases become so by infection introduced from without.

Only 5 per cent. of the 1,505 deliveries in the Leeds Maternity Hospital during 1925 were morbid, as judged by the British Medical Association standard. Of the normal deliveries numbering some 1,200, only thirty were morbid according to the British Medical Association standard, and of these thirty, eighteen were morbid on not more than three occasions. A midwife would have had to report only twelve cases as being morbid.

All patients admitted to this hospital from outside after operative interference were given 40 c.c. of anti-streptococcus serum. This serum was given in seventy-six cases. In fifty-seven cases the puerperium was normal, in three cases morbidity was noted on four or less than four occasions, while in twelve cases the morbidity was of longer duration. There were four fatal cases.

This, I think, is the lowest morbidity that has ever been claimed by any maternity hospital in the British Empire, and I consider it due to:—

(1) The minimum interference during delivery; (2) the free use of 1/1000 biniodide of mercury throughout the hospital; (3) the abolition of all binders, so

that the patients were free to sit up in bed within twelve hours of their confinement; (4) free purgation. Every patient received 2 oz. of castor-oil the morning after her delivery, and some purgative every night she was in hospital; (5) the serum given to contaminated patients. Without doubt this serum is of great value in preventing sepsis from occurring, if it is given soon enough, and in large enough doses. Once the patient is septic it appears to be absolutely valueless. A marked serum rash was noted in a few cases, and a rather severe anaphylactic reaction occurred in one patient. It is clear that if the serum is to be given at all it should be given in moderately large doses, and it is to be hoped that it will soon be offered for sale at a much lower price. The serum was not given to any non-contaminated patient, however severe the operation.

This low morbidity was obtained in spite of the fact that the hospital is badly constructed, and more than eighty patients were often nursed although there was only proper accommodation for fifty beds. I have often seen more than a dozen patients sleeping on mattresses on the floor. Puerperal sepsis is not caused by bad surroundings but by bad midwifery.

The Control of the Perineum.

In an effort to get further back to nature I requested the sisters to allow 100 women to deliver themselves, by themselves, while the nurse was standing at a distance from the bed, with the following results:—

	No.	Perineum intact	Perineum lacerated
Primiparæ ...	35 ...	18 ...	17
Multiparæ ...	65 ...	62 ...	3

This was termed the "Garden of Eden" method of delivery. Two hundred cases were then delivered by the modified "Garden of Eden" method. All the nurse did was to prevent the head from being born "with a flop." The results were as follows:—

	No.	Perineum intact	Perineum lacerated
Primiparæ ...	80 ...	63 ...	17
Multiparæ ...	120 ...	116 ...	4

The woman is allowed to get into any position she chooses. There is no feeling for the cord, there is no lifting of the leg, causing the woman to feel exposed, and there is no possible contamination of the nurse's hands with the contents of the bowel. This method, while interfering with nature as little as possible, gives results which are as good, if not better, than any ritual for the control of the perineum.

There is one more subject to which I should like to allude. Some two years ago Dr. Bigger and I read a paper before the Royal Academy of Medicine in Ireland showing that gloves could be sterilized by washing with soap and water, using a scrub brush if necessary and then immersing the gloved hands in 1/1000 biniodide of mercury for half a minute. Nobody has disputed the truth of these contentions, but some have said that the doctrine is dangerous.

At the present moment the great majority of midwives in practice get fæces on their hands every day, and make vaginal examinations without gloves. Boiling destroys the gloves, whereas if the gloves are washed and treated with the care that is bestowed on a crêpe-de-chine camisole, they will last for a long time. I contend that it is much safer for a midwife to use gloves so sterilized, and not to make vaginal examinations, than to make vaginal examinations with her bare fingers which cannot be sterilized. Fæces are gross dirt and can be easily washed off, and they are often less harmful than the discharges of the vagina which may not have an offensive odour.

Further, it is impossible for a doctor to apply the forceps or to clear out an abortion single-handed, in an antiseptic manner, unless he adopts the method I have suggested. There is no need for a sterilized drum to conduct midwifery with safety.

In the Leeds Maternity Hospital I neither used nor allowed the assistant to use any sterile towels in the delivery of such cases as might have to be treated in a private house.

In conclusion, the results in midwifery in England and Wales are bad, and are a great deal worse than the figures would suggest. The solution of the problem lies in a return to nature, and in better midwifery. This desired result can only be obtained by drastic changes in the teaching of midwifery. I suggest that the whole attitude towards midwifery be altered and that:—

(1) Nurses be forbidden to make vaginal examinations.

(2) Nurses be forbidden to deliver breech presentations.

(3) Nurses be forbidden to control the fundus during the third stage.

(4) That the modified "Garden of Eden" method of delivery be adopted.

(5) That binders be abolished, and free drainage and purgatives during the puerperium be obtained.

(6) That several large combined gynæcological and maternity hospitals be instituted on the lines of the Rotunda Hospital.

(7) That the student should spend less time watching operations he will never perform, and a great deal more time watching normal labour, while living in a maternity hospital. There is no need for him to spend more time at gynæcology.

The efforts at improvement during the last twenty years have failed. The general public are getting alarmed. There is, I fear, a strong probability that a State Medical Service may be forced on the profession, and the bad state of midwifery may be a strong argument in its favour.

When, however, I reflect on the care, skill, team work, and money expended in the operating theatres of our land in patching up broken men and women, and reflect on the inadequate training which allows men to kill and cripple women in their prime, women who are performing the act for which they were primarily created; when I consider the sum total of misery which is daily mounting up through bad obstetrics, when I consider that the names of Smellie and Hunter are no longer mentioned in the literature of obstetrics—I feel constrained in all humility to make a plea for radical changes in the attitude towards midwifery, and to hope that these changes will be made by the profession before unnecessary and ill-directed control is exerted by the State.

Discussion.—Lady BARRETT expressed the thanks of the Section to Dr. Theobald for his spirited paper on behalf of mothers. She considered his warnings against over-interference in the guarding of the perineum and the control of the uterus after birth as practically useful. Dr. Theobald had also indirectly pointed the way by which we might avoid precipitate interference in labour in private practice due to the importunities of the patient and her friends; namely, by more systematic teaching about and use of suitable analgesics during the early stages of labour.

Dr. J. S. FAIRBAIRN said he considered Dr. Theobald's paper timely and justified by the conditions now prevailing in the teaching and practice of midwifery. Reform was urgently called for, and he would advocate a return to fundamental principles as the most essential need of the present day.

Throughout medicine the ultimate objective was the maintenance of normal function, and in obstetrics our efforts must be directed towards securing for our patients a physiological pregnancy, parturition and puerperium. Till this principle was recognized and acted upon whole-heartedly by all teaching and practising midwifery, the frequency of disasters, such as those quoted that evening, would not be lessened. Many practitioners would appear to consider that their function was to get their patients delivered somehow, but, in any case, as quickly as possible.

At the Portsmouth meeting of the British Medical Association he (the speaker) had urged a more extensive study of, and greater effort to attain, physiological parturition, but his views were pooh-poohed as visionary and impossible in practice. Dr. Theobald would find that even if he brought up his students in the way they should go, it would not necessarily follow that when they had grown up into practitioners they would not depart from it. However well-drilled in the methods he had advocated, few of them would also have the strength of

character to overcome the pressure of entreaty from patients and relatives to terminate labour early and artificially, and yet survive in the competition for practice. He knew striking instances of his own students and house officers, strong both in faith and in purpose, who had regretfully acknowledged defeat in the struggle.' In other words, the public also required education, and without some change in the system and conditions of maternity practice, reform, like the labours, would be difficult and delayed.

The reader of the paper seemed to be unduly severe on the midwife and her training, but surely a wider use of her services must be part of the campaign on behalf of physiological parturition. If the true criterion of success was the degree of the physiological parturition attained, the best results were to be found where the trained midwife conducted the labours and sent for medical aid only when there was need for it, as shown not only by the better maternal mortality rates in those countries with a well-organized service of midwives, but also by individual results in this country when this system was adopted. In working out the figures of the East End Mothers' Home for the past four years he had found over 95 per cent. of normal and unassisted deliveries, a forceps rate of but 1 per cent. in outdoor cases, and under 4 per cent. in cases in the hospital, with only six maternal deaths in nearly 9,000 deliveries, or a rate of 0·66 per 1,000, about one-sixth of that of the country generally. The midwives of the Queen Victoria Jubilee Institute, who attended over 50,000 cases a year, had a rate of less than half the national rate, and in both these instances the medical assistance obtained by the midwife was that of a local practitioner.

Another point to which he would call attention was in regard to Dr. Theobald's advocacy of the Rotunda plan of having an experienced Master resident for seven years in supreme charge, in preference to visiting consultants. That plan was advocated by the Committee on Teaching in a report to the Council of this Section and adopted by it in 1919, though there was a minority report against it. The details would be found in the *Proceedings* for that year.[1]

[*February* 4, 1926.

Specimen of Endothelioma of the Ovary.

Shown by W. McK. H. McCULLAGH, D.S.O., M.C., F.R.C.S.

THIS tumour was removed from an unmarried girl, aged 23.

Her periods began at the age of 17, were normal until she was 21, after which for two years she lost successively five to seven weeks, with one week's interval of freedom. She lost continuously for three months in the spring of 1925, and was curetted by a local doctor without relief.

Later on, having lost for nine months continuously, she was seen by a doctor who urged me to admit her to hospital. I found on examination a movable firm lump in the pelvis, which I took to be a fibroid.

The operation was carried out on November 30, at the Metropolitan Hospital, and on the abdomen being opened a large solid ovarian tumour was found, the size of a duck's egg. On section it was of a bright yellow colour, and appeared to be encapsuled with the ovarian stroma pushed aside to one end of the growth.

The section shows an endothelioma with strands of cubical cells.

Since then she has had two normal periods of three to four days, and is improving rapidly.

REPORT OF THE PATHOLOGY COMMITTEE OF THE SECTION OF OBSTETRICS AND GYNÆCOLOGY.

" We consider from the various appearances that the tumour is an endothelioma of the ovary.

(Signed) T. G. STEVENS,
HERBERT SPENCER,
JOHN BARRIS,
ALECK BOURNE,
A. C. PALMER,
EVERARD WILLIAMS."

[1] *Proceedings*, 1919, xii (Sect. Obst. and Gyn.), p. 124.

Section of Obstetrics and Gynæcology.

President—Mr. T. G. Stevens, F.R.C.S.

Two Cases of Adeno-fibroma of the Ovary.

By Herbert R. Spencer, M.D.

Case I.

E. A., aged 62 (eleven children, four abortions), was admitted to University College Hospital on October 31, 1908, from a medical ward where she had been admitted for ascites under the care of Sir John Rose Bradford, who, finding no usual cause for the ascites and suspecting a ruptured ovarian cyst, placed her under my care.

For four months she had had swelling of the abdomen which came on gradually and was accompanied by pain across the upper part; on leaning forward she had had a sensation of something giving way in the lower part of the abdomen. The distension had increased during the last fortnight.

Menstruation began at 14, was regular, lasted four to five days and ceased at 45. The bowels had been rather constipated since the menopause. The urine was scanty and dark, specific gravity 1020, free from albumin and sugar. There had been some discomfort after food, but no vomiting. There was no vaginal discharge. The patient had lost a good deal of flesh during the last few months.

She had had rheumatic fever three years ago, and typhoid fever and abscesses in the chest-wall nine years ago. Four of her children had consumption.

There was some œdema of the legs. The heart-sounds were normal except for slight accentuation of the second sound. The breath-sounds were weak at the bases, elsewhere normal.

The abdomen was greatly distended, measuring 43 in. in girth at the umbilicus and contained a large quantity of free fluid, with shifting dullness. No definite tumour could be felt either by the abdomen or the vagina, the abdomen being very tense; but under anæsthesia a tumour could be felt in the right iliac region. The case was diagnosed as a ruptured ovarian cyst.

At the operation on November 2, 1908, a large quantity of straw-coloured fluid escaped and a tumour could then be felt occupying the lower abdomen. It proved to be a large multilocular cyst of the right ovary which had ruptured; masses of friable growth protruded through the rupture. There were no adhesions and there was no sign of secondary growth anywhere in the abdomen. The pedicle was ligated with silk, and the left ovary, which contained a small hard nodule (*adeno-fibroma*) in its substance, was also removed (see fig. 1).

The abdomen was flushed out with saline fluid and the abdomen closed by through stitches of silk-worm gut, silk (continuous for the peritoneum and interrupted for the fascia) and silk-worm gut for the skin.

The operation lasted thirty minutes.

The wound healed by the first intention, the highest temperature being 100·8° F. on the fifth day and absolutely normal after the eighth day.

The patient was quite well and the scar sound when examined on May 2, 1911, and she wrote that she remained well, at the age of 78, in February, 1925, over sixteen years after the removal of the tumours.

Microscopic sections of the large multilocular cyst showed it to be lined with columnar epithelium. The masses of growth are made up of a large number of gland spaces lined by columnar epithelium: the epithelium is not in a single layer but in two or three layers; there is no filling of the spaces and no breach of the basement

membrane. The cells are large and transparent with large vesicular nuclei; the cell outlines are often indistinct and very irregular in shape. The note was made, "There is a very great suspicion of malignancy about the appearance of the tumour."

The left ovary (fig. 1) measured 2·9 by 1·9 cm. At its outer end is seen a nodule 1·5 cm. in diameter, the outer surface of which is smooth and white, contrasting with the ordinary corrugated surface of the rest of the ovary. The cut surface of the ovary apart from the tumour is normal; it shows three corpora fibrosa 2 to 3 mm. in diameter towards its free border. The tumour is a discrete, hard fibrous body 1·5 cm. in diameter, of a yellowish-white colour, with fine white strands just visible to the naked eye permeating it in all directions. These are seen, with the aid of a lens, to enclose more or less rounded spaces which are filled with a solid

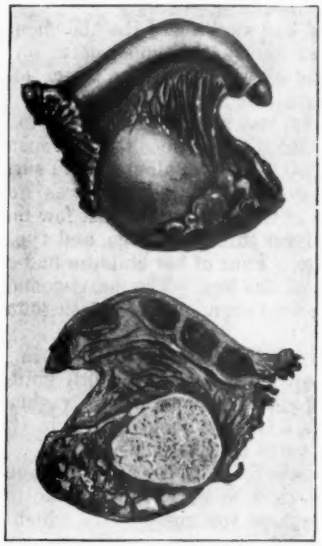


FIG. 1.

(*Case I*, natural size).—Showing the size and appearance of the ovary with adeno-fibroma, on the surface and in section.

homogeneous substance, but in some places show softening or commencing minute cysts. The tumour could easily be enucleated from the surrounding tissue.

Microscopic Structure.—The tumour is an *adeno-fibroma*, consisting of dense fascicles of fibres enclosing spaces filled with large masses of epithelial cells, with complete absence of leucocytic invasion. The structure is similar to that of the solid part of the ovarian tumour in Case II, except that few of the masses have central spaces and there are no glands lined with a single layer of epithelium. (The specimen is No. 526 Gyn. Collection, University College Hospital Museum.)

CASE II.

H. G., aged 77 (5 children, 1 abortion), was admitted to University College Hospital on November 10, 1924, complaining of swelling of the abdomen and of a bloody discharge which she had noticed for four years, and of occasional slight abdominal pain.

Menstruation began at the age of 15, was regular, every four weeks, lasted seven

days, was rather profuse and ceased at the age of 40. She had had a continuous trickle of urine for four years, especially if she took any exercise.

The patient looked healthy, but was not cheerful. The pulse was strong and regular; the heart sounds normal; bronchitic râles were present.

The urine (specific gravity 1030) contained an excess of urates, but was free from albumin and sugar.

The abdomen was enormously distended by an irregular tumour, typical of a multilocular ovarian cyst. The abdominal girth was 42 in. (22 in. in the right, 20 in. in the left half). The legs were not swollen. The cervix was large, but healthy. The body of the uterus appeared to be rather large and on its left was a large, hard mass which felt like a calcified fibroid. The lower end of this tumour entered the pelvic brim. The relation of the tumour to the uterus could not be made out clearly. The patient bled a little after the examination.

The diagnosis was a multilocular ovarian cyst, a calcified fibroid (probably of the uterus), and probably cancer of the body.

On account of her age and the presence of bronchitis it was not thought advisable to curette the uterus for the purpose of diagnosis and it was decided to remove the tumour and uterus by abdominal section.

On November 13 the patient complained that her left leg had felt cold and painful for the last few days; on examination of the leg varicose veins were seen, but there was no evidence of thrombosis or anything else abnormal.

Operation.—On November 15, 1924, through a paramedian incision extending from the umbilicus nearly to the pubes, the cyst was exposed and tapped, then removed and the pedicle tied with silk. The uterus, together with the left ovary, was then removed by Doyen's method and the pelvic peritoneum was closed by a purse-string suture and the abdominal wound sutured as in Case I; an iodoform gauze plug was inserted in the vagina. The operation lasted seventy minutes.

After the operation the patient slept about four or five hours; but she had to have bromide on succeeding days as she was restless and did not sleep well. The temperature had only risen to 99·2° F. on the day of the operation; but on the 19th (the fourth day) a short rigor occurred and the temperature rose to 102·4° F. and the respiration to 36. Next day the patient felt better, but on the 21st she had another slight rigor and the temperature rose to 101·4° F.; respiration 32.

On the 22nd the abdominal stitches were removed; the wound appeared perfect and there was no swelling or tenderness in the abdomen. The patient looked better; but had another slight rigor in the night, the temperature rising to 103·4° F. At that time she was very blue and was unconscious for twenty minutes. Again, on the 23rd she had a shivering attack.

On the 24th she seemed better—the temperature had dropped to normal. The patient was recovering her appetite.

On the 25th she had a rigor at 2·30 p.m. and the temperature rose to 101·6° F. The patient was very drowsy and scarcely conscious.

On the 26th, on the eleventh day after the operation, she became comatose and died at 10·30 p.m.

Unfortunately a post-mortem examination could not be obtained.

The *uterus* measured 4 in. by $2\frac{3}{4}$ in. by $1\frac{7}{8}$ in., and, except for two minute cysts in the corporeal endometrium, looked normal to the naked eye. Microscopic examination showed only œdema and congestion, with some hyaline changes in the muscle fibres.

The right ovarian tumour consisted of a hard solid lower part and a large upper cystic part resembling a multilocular cyst (fig. 2). The cystic part had been tapped and contained pseudomucin, in parts coagulated. The tumour, after removal of the pseudomucin, weighed 4 lb. 4 oz.: the lower, solid part, was very dense and hard and in places calcified.

FIG. 2.

(*Case II*, two-thirds natural size).—Showing the appearance of the adeno-fibroma and the multilocular cyst. The adeno-fibroma extends from the surface right up to the multilocular cyst; it has a mottled and fibrous appearance on section and the orifices of vessels and minute cysts are seen scattered over the surface. The smaller daughter-cysts contain coagulated pseudo-mucin. The large ruptured cyst, which, before rupture, filled nearly the whole abdomen, is collapsed.

On section the cystic portion contained jelly-like material in the smaller cystic spaces: under the microscope the lining of these spaces was a high columnar epithelium, in places thrown into folds, as usually seen in multilocular cysts: the epithelium lining the cysts was not proliferated.

The solid part measured in section 5 in. by 6 in., was of a yellowish white colour and showed a dense, somewhat striated and mottled appearance and some minute cysts; the section grated under the knife.

Under the microscope the solid growth is a dense fibroma, in parts calcified, beset with spaces filled with epithelioid cells looking not unlike epithelioma; but there is no evidence of invasion of the stroma. For the most part the masses are solid; but in places they are hollow in the centre: this is evidently due to the degeneration of the central cells (fig. 3). In one section, however, two gland spaces are to be found exactly resembling corporeal uterine glands cut across, with a single layer of columnar epithelium, but with no cytogenous stroma around them.

FIG. 3.

(*Case II*).—Photomicrograph (low power) showing to left columnar epithelium of multilocular cyst, to right fibroma with five epithelial masses; the lower two of these are solid, the upper three contain small, irregular spaces due to degeneration of the central epithelial cells.

The dense fibrous stroma is found immediately beneath the epithelial lining of the multilocular cyst (fig. 4) and is well seen in sections stained by van Gieson's method. The thick degenerated stroma in places somewhat resembles the wall of a blood-vessel (fig. 5), suggesting at first sight the possibility of the growth being an endothelioma; but careful examination does not support this, the vessels in the growth showing no proliferation in the endothelium. The growth is an *adeno-fibroma*.

The *left ovary* measured 1½ in. by 1 in. by ½ in. and was thus much larger than is usual in old age. On section it contained a few corpora fibrosa. The ovarian tissue consisted of dense connective tissue and contained no Graafian follicles. The vessels were numerous and thick-walled. In the hilum were seen three tubules lined with a single layer of cubical epithelium. There was no sign of proliferation of the epithelium or of masses of epithelium, as in the tumour of the right ovary.

FIG. 4.

(*Case II*, × 65).—Showing the epithelial lining of the multilocular cyst with the fibromatous tissue extending up to it. Three large and two small masses of epithelial cells are seen; the nuclei of the fibres around these stain somewhat more deeply than elsewhere, but there is no leucocytic infiltration and the masses are clearly differentiated from the fibrous surroundings.

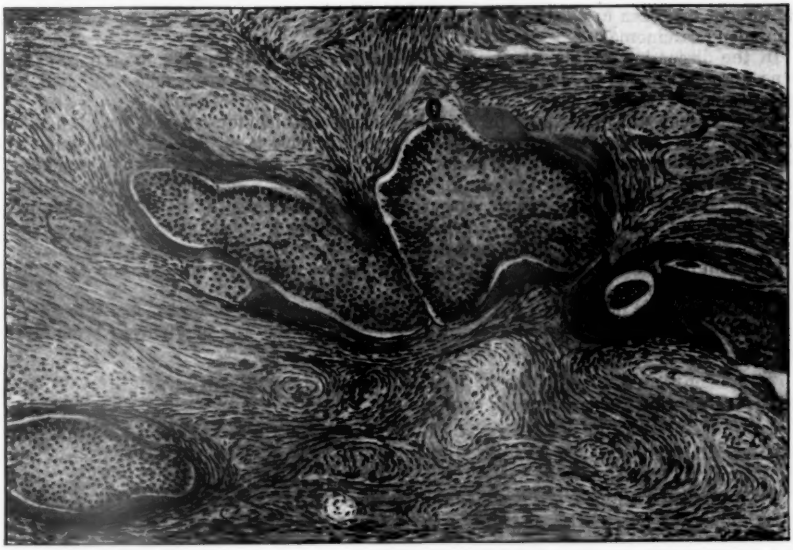


FIG. 5.

(Case II, × 65).—Showing hyaline degeneration of the fibrous tissue around the epithelial masses, which are clearly differentiated from their surroundings; there is no leucocytic infiltration. The peripheral epithelial cells are somewhat columnar, the central cells polygonal.

Three cases of ovarian adeno-fibroma have already been brought before this Section.

(1) *Macnaughton Jones's Case.*— At a meeting of the Obstetrical Society of London on April 6, 1898, the late Dr. Macnaughton Jones showed an "anomalous ovarian tumour" (*Trans. Obstet. Soc.*, vol. xl, p. 154). The illustration is Plate IV (*loc. cit.*), opposite the text, which contains no reference to the Pathology Committee's Report (*loc. cit.*, p. 213) that was signed by H. Macnaughton Jones, Herbert R. Spencer, J. H. Targett and T. W. Eden. The report, after the description, states "we are of opinion that the tumour is not malignant and that the arrangement of the epithelium most nearly resembles that met with in some forms of adeno-fibroma of the breast." In this case "the right ovary was healthy" and apparently was not removed. The tumour was removed from a multiparous widow, aged 47, who remained well over eleven years after the operation (*Proc. Roy. Soc. Med.*, 1909-10 iii, Sect. Obst. & Gyn., p. 72).

(2) *Darwall Smith's Case.*—On June 10, 1909 (*Proc. Roy. Sec. Med.*, 1909, ii, Sect. Obst. & Gyn., p. 302) Dr. Darwall Smith showed microscopic sections of a "tumour of the ovary ? adeno-fibroma or endothelioma"; the specimen itself was not shown, having been mislaid, but is said to have been almost spherical and about the size of a clenched fist. Three excellent photomicrographs show a structure similar to that of the other cases recorded and these now shown. The tumour was removed from a woman, aged 36, who had had three children. The left ovary appeared to be normal and was not removed. The patient was free from recurrence more than two years after the operation (*loc. cit.*, vol. iii, p. 53).

(3) *Arthur Giles's Case.*—On November 11, 1909 (*Proc. Roy. Soc. Med.*, 1909-10, iii, Sect. Obst. and Gyn., p. 51), Dr. Arthur Giles showed before the Section "a large solid ovarian tumour ? adeno-carcinoma," which he had removed from a widow aged 60. The tumour was almost solid and weighed 18 lb.; "a small portion presents the characteristics of a multilocular cyst."

The tumour had been in existence about sixteen years. It was reported on by Dr. Lockyer as an adeno-carcinoma.

In the discussion on this case I pointed out reasons for believing it to be a non-malignant adeno-fibroma, alluded to Macnaughton Jones's similar case and mentioned one I had had of the same nature (Case I).

The specimen was referred to the Pathology Committee, which reported "a fibro-adenoma of the ovary of unusual character, with marked proliferation of the epithelial cells, which, however, are encapsuled and do not present definite malignant characters." Six members of the Committee (whose names are given) "wish it to be recorded that in their opinion the groups of epithelial cells found in the alveolar spaces in the fibrous stroma are malignant." It is a pity that an illustration of the tumour was not published, especially as it is stated that "a small portion presents the characters of a multilocular cyst"; in the absence of microscopic examination it is impossible to say whether this was an ordinary cyst-adenoma or a degenerated portion of the solid tumour.

Dr. Giles kindly informs me that the patient survived the operation for thirteen years. There was no sign of recurrence, her death occurring at the age of 73 from bronchitis and a kind of fit.

The occurrence of *fibroma* or *fibromyoma* in the wall of ovarian cysts is well known; I exhibit two specimens to-night.

In one the tumour measured 1·5 cm. in diameter and 6 mm. in thickness, and occurred in the wall of a unilocular ovarian cyst of the size of an orange (Gyn. Collection, *University College Hospital Museum*, 1911, No. 423).

In the other there were two tumours measuring 2 by 1·7 by 0·5 cm. occupying the whole thickness of the wall down to its membranous lining; they occurred in the wall of a unilocular cyst measuring 13 by 9·5 by 8 cm. There were papilliform projections of the mucosa in places. (Gyn. Collection, *University College Hospital Museum*, 1911, No. 438).

Adeno-fibroma is a much rarer tumour. There can, I think, be no doubt of the diagnosis in both of my cases and in the three others quoted. The appearance of the epithelial cells, the sharp delimitation of the epithelial masses from the stroma, the absence of any tendency to invasion and of small-cell infiltration, the long history of the cases and the absence of recurrence in Macnaughton Jones's case (eleven years), Darwall Smith's (two years), Giles's (thirteen years), and Case I (sixteen years), point to the non-malignant nature of the growth.

A feature to which I wish to direct attention is the *association of the adeno-fibroma in my cases with multilocular ovarian cystoma*, in one case in the same ovary, in the other in the opposite ovary. It is probable that Giles's case was associated with a multilocular cystoma in the same organ; in Darwall Smith's case the tumour was not shown; but the microscopic section shows a small cyst in the ovarian tissue outside the adeno-fibroma.

In Macnaughton Jones's case the part of the ovary not involved in the growth and the other ovary appeared to be normal. The adeno-fibroma was associated with a uterine fibroid.

Thus, in four out of five of the English cases the adeno-fibroma was associated with cystic disease of the ovary. I call attention to this fact in order that subsequent observers may record the presence or absence of this association, and to suggest the importance of making sections of the other ovary, if removed, even though it shows no apparent abnormality. It seems possible that we may thus obtain valuable information on the origin of these rare tumours, which is obscure, and on the correlation of tumours of different structure, which is attracting so much attention at the present time.

Glockner (*Archiv für Gyn.*, lxxv, Hft. 1, p. 103) and Orthmann (*Monatsschr. für Geb. und Gyn.*, 1899, ix, p. 779) have published as cancer, cases which appear to be typical cases of adeno-fibroma. Glockner's patient died, a year after the operation, of apoplexy, and no post-mortem examination was made; an interesting feature in his

case is that the other ovary showed the same structure when cut in serial sections. In Orthmann's case, which he styles an "adeno-fibroma cysticum carcinomatosum," the other ovary was atrophic. In spite of intimate adhesions of the growth to the intestine the patient remained well four years after the ovariotomy.

Pfannenstiel, in Veit's, "Handbuch" expressed his opinion that cases published as adenoma and fibro-adenoma of the ovary "belong to the carcinomata." He does not seem to have had any personal experience of these tumours and excuses himself from dealing specially with them on account of their extreme rarity.[1]

Gynæcologists rightly attach importance to proliferation of the epithelium lining glands or cysts and covering papillomata; in the diagnosis of malignancy, and in the case of the uterine glands (except in carcinoma adenomatodes) this reliance is usually well placed. In the case of ovarian tumours, however, this proliferation is not infrequently an untrustworthy test, as in Case I, where the patient remained well for over sixteen years in spite of rupture of the cyst and the projection into the peritoneum of masses of papilloma with proliferated epithelium.

The diagnosis of malignancy in ovarian tumours is deserving of further study. I have published in the *Proceedings* two cases, microscopically typical soft medullary carcinoma, which, although ruptured, remained well for seven and six years after removal.[2]

With regard to the dense tumours considered in this paper I think there can be no doubt that the report of the Committee of the Obstetrical Society, made twenty-seven years ago, that they are non-malignant adeno-fibromata, remains true, and that Pfannenstiel, Glockner and Orthmann were in error in attributing to these growths malignant characters.

Discussion.—Mr. T. G. STEVENS (President) said that he was familiar with this type of growth, having examined several specimens of it. In some of these tumours the appearances were very puzzling, presenting not only alveoli lined by a single layer of columnar epithelium, but also solid masses of cell-elements in a fibrous stroma. In some of the latter the appearances were very suggestive of endotheliomata, but this could not be confirmed. In other specimens suspicions of malignancy arose from histological appearances, but these suspicions were not confirmed by the clinical histories of the cases. In some of the specimens, like that of Dr. Spencer, there were large cystic spaces with pseudo-mucinous contents as well as small undilated alveoli. This he (the President) thought might indicate that these tumours were only a phase in the life-history of large multilocular pseudo-mucinous cystic adenomata, and he considered it was curious that the beginnings of the common cystic adenomata were seldom seen.

Dr. HERBERT SPENCER (in reply) said he agreed with the President that *small* pseudo-mucinous cysts were rare; he had, however, met with one not bigger than a marble in a new-born child. He was not in favour of the suggestion that pseudo-mucinous cysts ordinarily developed from adeno-fibromata: the common pseudo-mucinous cyst was scantily supplied with fibrous tissue and the pseudo-mucin was a secretion and not a mere degeneration of cellular masses.

A Contribution to the Technique of Cæsarean Section.

By F. J. McCANN, F.R.C.S.

CÆSAREAN SECTION is an operation so frequently performed throughout the world, and is, in properly selected cases, of such benefit to the patient and her unborn child, that the technique of the operation must always demand careful scrutiny, in order that the greatest degree of perfection may be attained. In the search for the "ideal operation" modifications have been suggested from time to

[1] *Verhandl. der Deutsch. Gesellsch. für Gyn.*, 1905.

[2] *Proc. Roy. Soc. Med.*, 1915, viii Sect. Obst. and Gyn., p. 61; and 1923, xvi Sect. Obst. and Gyn., p. 105.

time, mainly in the position of the uterine incision, in order to prevent rupture of the uterus in subsequent pregnancy. This accident is believed to happen in about 4 per cent. of the cases.

The frequency of rupture of the uterus after Cæsarean section has prompted obstetric surgeons to try incisions in the lower uterine segment, and this method, adopted not only on the Continent but also in Great Britain, is still on its trial. These low incisions are not, however, so satisfactory as high incisions. I have always made a high uterine incision and it is from the experience thus gained that I venture to advocate the method about to be described.

If the contractions of the uterine muscle be observed the contraction wave is seen advancing from the uterine cornua towards the middle line of the uterus and downwards towards the lower uterine segment. Moreover, the contraction wave is most marked in the region of the fundus, and when a sagittal fundal incision has been made the edges are firmly pressed together when the uterus contracts, whilst if the incision be made accurately in the middle line there is a corresponding diminution in the amount of blood lost. Accuracy in this regard is most important, as it is in the operation of myomectomy; for the middle line of the uterus is relatively avascular. In the *Journal of Obstetrics and Gynæcology*, 1906, p. 160, I drew attention to the importance of a mesial incision in myomectomy in my report of the Fifteenth International Medical Congress at Lisbon. In the pregnant uterus it is still more necessary to incise in the middle line.

It was as a result of making a high uterine incision and of rapidly separating the placenta when it was encountered in or near the incision that I conceived the idea that by performing a sagittal fundal incision I would be enabled to remove the placenta and the fœtus contained in the unopened bag of membrane.

In June, 1922, I had an opportunity of putting my ideas to the test, through being requested to operate on a patient whom I had delivered by the Cæsarean operation years previously. She was a rachitic dwarf, and was 35 years of age. She had been married for ten years and had had four pregnancies, two ending in a miscarriage. Her first labour was terminated by craniotomy, whilst a further pregnancy was terminated by induction of labour with death of the child.

She was seen by me in her fifth pregnancy and was operated on as soon as labour began. The uterus was incised through a high incision and a male child rapidly extracted. The mother made an uneventful recovery and was highly pleased to possess a living child.

Unfortunately at the age of two years the child died of broncho-pneumonia. I was again asked to see this patient in June, 1922, and found that she was again pregnant and near her full time, and that her maternal instincts were so strong that she was quite prepared to undergo a second Cæsarean section in order that she might possess a living child. This operation was accordingly performed two or three days before the date of her expected labour.

I will now direct attention to some of the special points in the technique of this operation.

The abdominal incision was made above the umbilicus for the greater part of its extent. This incision in part opened into that of the first operation, but was prolonged upwards to a higher level. The length of the incision must depend on the size of the uterus, but it should be sufficiently long to permit the uterus to be eventrated without difficulty. The position of the incision should be regulated by the position of the uterine fundus. An incision 6 in. or 7 in. in length will usually be required and the greater part of this incision will be above the umbilicus. When the abdomen has been opened the uterus is at once eventrated and the abdominal incision temporarily closed by volsellæ or long Kocher forceps, and covered by a towel wrung out of hot saline solution.

Another towel wrung out of hot saline solution is wrapped round the eventrated uterus—leaving the fundus exposed—and is clamped by forceps along the posterior uterine wall. The lower edge of the towel is spread out on the cloths protecting the skin of the abdomen. This method effectually prevents any fluid, escaping from the uterus, entering the abdominal cavity. All this is done with the utmost rapidity and the towels and instruments required should be in readiness before the abdominal incision is made.

I have always eventrated the uterus in performing Cæsarean section because I prefer to see exactly what I am doing, and to be certain that the uterine incision is in the middle line.

It is stated that eventration increases the shock of the operation, but I do not find that it does, if the precautions mentioned are taken. The uterus is kept warm by the towel and there is no unnecessary handling of its peritoneal surface. The uterus is usually eventrated, after the child is extracted, for the purpose of suturing the uterine incision, and it is totally unprotected. Moreover, sponges or gauze require to be packed around the incision to protect the abdominal cavity from the ingress of liquor amnii or blood.

As already stated only the uterine fundus is left exposed and a mesial incision about 6 in. to 7 in. is made through the fundus, being prolonged 1 in. further downwards anteriorly, than posteriorly.

A sharp knife should be used, and care taken not only to make the incision in the middle line—taking the guide from the ends of the Fallopian tubes, but also to avoid puncturing the membranes. Enlarging the incision with scissors or, still worse, tearing, should be avoided, a sharp knife alone being used and the length of the incision gauged by the width of the fundus, from before backwards.

Tissues heal best when cut with a clean sharp knife.

I should mention that the site of the former uterine incision was visible as a fine white line and tiny pieces of linen thread could still be picked off the surface of the uterus nearly three years after the first operation! The portion of the thread which had penetrated the uterine wall had become absorbed, whilst that lying on the peritoneal surface still defied or, may be, had escaped the leucocytic invaders. The union of the uterine wall appeared to be as near perfection as it was possible to attain.

After the fundal incision had been made the membranes bulged into the anterior half of the incision and the placenta was exposed through the posterior half. The hand was then inserted and the placenta rapidly separated from the uterine wall.

The assistant was now instructed to draw the two sides of the uterine incision apart, and I compressed the two sides of the uterus at its lowest part through the towel, and gently "milked" the uterine wall from below upwards, when the placenta and fœtus contained in the unopened bag of membranes was shelled out of the uterus like a pea out of a pod. Whilst the assistant compressed the uterine incision I slit up the bag of membranes and liberated the child. After the child had breathed I clamped and cut the cord.

The uterine incision was sutured with through-and-through linen sutures and superficial catgut sutures. The uterus was then returned into the abdominal cavity, the omentum brought down and placed over the intestines behind the uterus, and the abdominal wall closed in layers. The patient made a smooth recovery, and her child, a male, has remained well.

Cæsarean section is one of the most dramatic operations in surgery, but it becomes still more dramatic if it is done in the manner described.

There was very little hæmorrhage from the uterine incision, and all soiling of the abdominal cavity was completely avoided. There was no escape of liquor amnii to deluge the patient, the operator or the assistant. The operator's gloves are not covered with vernix caseosa from handling the fœtus, and the whole operation can be completed with a degree of cleanliness difficult to excel.

I do not claim originality in the making of a sagittal fundal incision, but in the method of extracting the placenta, membranes and contained fœtus through this incision. A sagittal fundal incision has been advocated by Müller[1] in Germany and Caruso[2] in Italy. I am surprised, however, that the advantages of this incision have not made a stronger appeal to British obstetric surgeons. It is incomparably superior to the transverse fundal incision of Fritsch, both on anatomical and physiological grounds, and is well worthy of an extended trial in this country.

It is true that a high, and even a long, abdominal incision is required, but this is of little consequence provided the abdominal wall be accurately sutured; indeed, I am not sure if a high incision is not an advantage in avoiding the risks of a post-operation hernia. Through a sagittal fundal incision the surgeon at once commands the position of a placenta wherever situated; whilst sufficient advantage has not been taken of the fact that normally the fœtal membranes do not adhere to the uterine wall but are easily separable, so that the introduction of a bougie to induce labour is not difficult.

[1] Müller, *Centralb. f. Gyn.*, 1898, No. 9, p. 225.
[2] Caruso, *Annali di Obstetrica Ginecologia*, November, 1911, p. 365, and 1912, p. 537.

The placenta, the greatest diameter of which is from 7 in. to 8 in., is inserted most frequently on the posterior uterine wall near the fundus. The placenta is stated to have been inserted on the anterior wall in 40 per cent. of Cæsarean sections. Sometimes the placenta is situated on one side of the uterus but seldom on the fundus.

Thus, in an overwhelming majority of the cases, a sagittal fundal incision exposes only a small portion of the placenta with a correspondingly small loss of blood, and the hand of the surgeon inserted at once through the uterine incision can rapidly separate the placenta, which is the most effectual method of arresting hæmorrhage. To advise that the surgeon who encounters the placenta under the uterine wound should burrow through it and then extract the fœtus—advice which is also given in the treatment of a complete placenta prævia, approached through the cervical canal—is to expose the patient to the added risks of profuse hæmorrhage.

Rapid and complete separation of the placenta is the best method of arresting hæmorrhage, and is of the greatest advantage when dealing with a quick placenta in abdominal pregnancy. Slow or partial separation of the placenta causes profuse hæmorrhage.

The absolute cleanliness of this method of Cæsarean section is one of its greatest advantages. It is freely stated that liquor amnii is an aseptic fluid, and that its entry into the peritoneal cavity does not matter; yet the majority of surgeons strive to prevent this peritoneal contamination. It seems to be forgotten that a fluid may be a chemical irritant although it be aseptic, and this, I believe, is true of the liquor amnii, and also that it causes post-operation abdominal pain and intestinal distension, and that blood produces a similar effect.

The so-called toilette of the peritoneum, a recognized step in the performance of Cæsarean section, is not necessary where the fœtal sac is removed unruptured.

The extraction of the child is easier through a sagittal fundal incision even if the surgeon has punctured the membranes, whilst the difficulty of extracting the child's head when the "waters" have drained away, and the uterus is firmly applied to the surface of the child, is lessened through the direct pull obtainable.

Again, in septic cases where the membranes have ruptured, the sagittal fundal incision presents certain advantages. The uterus can be thoroughly irrigated through this incision and as an alternative to sacrificing the uterus continuous irrigation can be maintained through a utero-parietal fistula. The uterine fundus having been accurately sutured to the abdominal wall, continuous or interrupted irrigation of the uterine cavity from the fundus to the cervix can be more effectually employed than through any other uterine incision.

The Trendelenburg position is useful when operating on septic cases, in preventing uterine discharges from contaminating the peritoneal cavity.

The Suturing of the Uterine Wound.

Recent discussions have shown the extraordinary divergence of opinion concerning the method of suturing the uterine wound. There will always be variations in method adopted by different surgeons but there are certain principles which form the foundation of efficient work. We will consider these principles as they affect: (1) The incision; (2) the material used for suturing; (3) the method of suturing.

(1) *The incision.*—The incision should be in the middle line of the uterus and should be a clean cut made with a sharp knife. All tearing or bruising means delayed healing. Before being co-apted the cut surfaces should be carefully dried, all blood or clots being removed.

(2) *The Material used for Suturing.*—A slowly absorbing or a non-absorbable suture should be employed for the uterine wall. Such a suture acts as a splint, maintaining the edges in apposition during the subsequent contraction and retraction.

Many surgeons rely on catgut alone, but its rate of absorption is so variable that it is only a question of time as to how soon a disastrous result will follow its continued use. Moreover, the possibility, remote though it be, that the catgut may be infected when introduced, from faulty preparation or other reason, or again that it may become subsequently infected, militates against its universal applicability. The suture materials I recommend are either linen thread or silkworm gut, and catgut for sutures of apposition. For septic cases silkworm gut is to be preferred. Thus the catgut is fortified by a slowly absorbing or non-absorbable suture, and its premature absorption prevented from doing harm.

(3) *The Method of Suturing.*—The method of suturing is probably more important than the material used, and is, I believe, responsible for the production of unsatisfactory union of the uterine wound and the subsequent rupture of the uterus when exposed to the strain of pregnancy and labour.

When the uterine incision is examined it is seen that its superficial portion has retracted outwards and that the cut surface slopes from without downwards and inwards. If, then, it be sutured with a straight needle, which has been so often advised and practised, it is impossible to obtain a grip of the whole uterine wall, and thus the more superficial portions of the wall are alone co-apted, whilst the deeper are left to chance. The supporting sutures should be inserted in a large curved round-bodied needle. The needle should be large and curved in order that a grip of the uterine wall may be obtained from the peritoneal surface down to, but not including, the lining of the uterine cavity. It should also be round-bodied because it does not cause bleeding when inserted into the uterine wall, whereas a sharp needle cuts like a knife.

The needle, armed with thread or silkworm gut, should be inserted a quarter of an inch from the cut margin, being passed outwards so as to obtain a good grip of the uterine muscle, then inwards, missing the lining of the uterine cavity, and in the reverse order on the opposite side. To facilitate the introduction of the sutures the assistant should be instructed to hold the sides of the uterine incision by means of his thumbs and fingers in the manner adopted for controlling hæmorrhage; the cut surfaces of the uterine wall being thereby straightened a good grip of the uterine muscle is obtained. The sutures should be inserted at intervals of half an inch along the length of the incision. It is a good plan to insert and tie the suture at each end of the wound before passing the others. These others are then passed and before they are tied all blood and clots are removed, care being taken that the whole thickness of the uterine wall on each side is brought into apposition.

Tying of the Sutures.

This is a most important part of the Technique of this Operation. It must never be forgotten that a suture is only a splint; it does not unite the cut surfaces, it holds them in apposition until Nature supplies the glue. Without the assistance of Nature the efforts of the surgeon would be futile. For this reason a suture should be so tied that the opposing surfaces of the wound are apposed without being constricted, and in the uterus these surfaces should not be whitened, or, in other words, rendered anæmic by the constriction, nor should the suture be pulled tight on the assumption that by so doing hæmorrhage is arrested. That nicety of adjustment, that apposition without constriction, which comes with practice and experience, is one of the highest developments of surgical art, promoting alike the healing of the wound and the future well-being of the patient. Nicety of adjustment is important in suturing a wound of the uterus, for both contraction and retraction continue for some days and thus sutures may become loosened or may cut out when they have been unskilfully applied.

Catgut sutures are next inserted to co-apt the peritoneal edges of the uterine

incision. A sufficient number should be employed to ensure accuracy of apposition along the whole line of the incision.

Any sutures or methods of suturing that tend to cause inversion of the line of incision should be avoided, the object aimed at being union of the cut surfaces without inversion.

The importance of the placental site in predisposing to subsequent uterine rupture is difficult to estimate. The fact that the results from the Cæsarean operation are improving all over the world, suggests that improved methods of uniting the uterine wound are responsible, the position of the placenta notwithstanding. A sagittal fundal incision here again is of advantage, for the placenta is rarely implanted entirely on the fundus.

If the uterine incision be carefully sutured it will stand the strain of pregnancy—even repeated pregnancy. I have been enabled to prove this by inspection of the uterine scar in the living woman. In 1910 I performed the first successful Cæsarean section for eclampsia gravidarum in this country.[1] The patient subsequently had two pregnancies, which, under careful treatment, passed off uneventfully, terminating in the birth of living children. Soon after her second confinement and five years after the Cæsarean operation she became suddenly ill, and was found to be suffering from an ovarian cystic tumour with twisting of its pedicle. I was again asked to operate, and on opening the abdomen found a large adherent ovarian cyst with a twisted pedicle. The cyst was successfully removed and I had an opportunity of inspecting the uterine incision.

The incision was firmly united and the silkworm gut sutures which had been used at the Cæsarean operation were still *in situ ;* as they had not caused any local irritation I did not remove them. Here, then, was a uterine incision which had stood the strain of two pregnancies without exhibiting any evidence of stretching or weakness.

The problem of suturing the incised uterus is similar to that of suturing the incised abdominal wall. In both, sutures of support and sutures of apposition are required, and the supporting sutures should be of a slowly absorbing or a non-absorbable material. It is only by attention to all these technical details that the Cæsarean operation will be freed from complications both immediate and remote, and rendered as safe as any major surgical operation. This operation has no parallel in any other department of surgery, and it is our bounden duty to render every assistance to those heroic women who risk so much for the sake of their unborn child.

Discussion.—Dr. HERBERT SPENCER remarked that the wisest of men had said "there is nothing new under the sun," and certainly this method of performing Cæsarean section was not new. It had some merits; but so many drawbacks that obstetricians, like himself, who had been acquainted with it for twenty-five years, had not been induced to employ it. As far as he (Dr. Spencer) knew, it was first performed and recommended by Fournier,[2] of Amiens, in 1901; later, he published many cases. Fournier called the operation "enucleation of the human ovum," and drew attention, as Dr. McCann had done, to the ease with which the uterus expelled the ovum aided by slight pressure with the hands—as easily, he said, as a cherry-stone escapes when pressed by the fingers.

The advantage of the method was that it prevented soiling of the peritoneum and wound with the liquor amnii, which would render it suitable for a case in which toxins were being absorbed from a dead fœtus.

The disadvantages were:—A long abdominal and uterine incision, delayed delivery of the child, which increased its risk; hæmorrhage when the placenta was separated; difficulty of removal of the placenta, if adherent; difficulty of removal of adherent chorion through a fundal incision, and especially the greater risk of intestinal adhesions to the fundal scar, which had led to fatal ileus in several instances.

[1] *Lancet*, 1910, ii, p. 789.

[2] M. Fournier, "Cinq opérations césariennes; énucleation de l'œuf humain," *Bull. de la Soc. d'Obst. de Paris*, 1901, iv, p. 16, and *Bull. de la Soc. d'Obst. et de Gyn. de Paris*, 1921.

For all these reasons he (Dr. Spencer) considered the fundal incision and enucleation of the ovum far inferior, in a routine operation, to the usual anterior incision in the body, which he agreed with Dr. McCann was superior to the incision in the cervix.

Dr. McCann (in reply to Dr. Spencer) said that he was not aware of the publication referred to by him, and that as far as he (Dr. McCann) was concerned this method of Cæsarean section was original.

Dr. Spencer appeared to be quite satisfied with the usual method of Cæsarean section, but there was always room for improvement; indeed, in his (Dr. McCann's) opinion every surgical operation could be improved. Routinism was the curse of the medical profession, and new methods should receive at least a fair trial. The objections urged against this method of Cæsarean section were easily overcome by a careful technique, and the possibility of intestinal obstruction from adhesion of the small intestine was less than after myomectomy. Dr. Spencer, however, saved the situation by stating his belief that in certain cases this method of Cæsarean section would be useful.

He (Dr. McCann) claimed that a sagittal fundal incision was incomparably superior, both on anatomical and physiological grounds, to the transverse fundal incision of Fritsch. Following the latter several examples of rupture of the scar had been recorded, but he was not aware that any examples of rupture of the scar were recorded after a sagittal fundal incision. He (Dr. McCann) had not seen gaping of the incision during this operation, on the contrary the edges of the incision were pressed together during the uterine contractions and he thought this would be so when the incision was made accurately in the middle line. He (the speaker) did not advocate this method for every woman requiring the Cæsarean operation, but he thought that it was a method to be adopted in suitable cases. In the treatment of septic cases it offered obvious advantages and might be the means of preventing the sacrifice of the uterus. It was a method which was worthy of an extended trial, for the obstetric surgeon was able to unite the thick muscular wall of the fundus and so obtain a strong scar calculated to stand the strain of pregnancy and labour. It placed in the hands of the surgeon an alternative method of considerable value.

Note.—I have now read the two papers by Fournier in the *Bulletin de la Société d'Obstétrique et de Gynécologie de Paris* (1901 and 1921) and find his technique is not the same. Fournier makes a uterine incision from the middle of the anterior surface to the fundus, and, to give his own words, "même à la rencontre s'il le faut de la paroi postérieure." A sagittal fundal incision is an essential part of the technique I recommend for the reasons stated, and the placenta alone requires separation. Further, the description leads one to infer that there is unnecessary delay in opening the membranes after enucleation, and in liberating the child.

On Total Transposition of the Viscera and its Clinical Importance.

By J. Ford Anderson, M.D., M.R.C.P.

[ABSTRACT.]

The author remarked that total transposition of the viscera is more than an "anatomical curiosity" and it deserves more interest from clinicians. There are many cases recorded, chiefly in America, where ignorance of the presence of the condition has led to wrong diagnosis and wrong treatment and even disaster. It is of special interest to obstetricians in its causation and diagnosis at birth. Cases are fairly numerous showing that total transposition and twins are allied abnormalities, both due to hereditary transmission; and Virchow's observation, made many years ago, was still valuable, that the vessels of the umbilical cord are wound from right to left instead of from left to right as is usual, and this is an indication of the position of the liver which, according to Serres, determines the "situs viscerum inversus." The importance of arriving at the frequency of the malformation is great,

and to this end practitioners should report such cases. Obstetricians are asked to note the presence of Virchow's sign of winding of the cord and report to the medical world if associated with transposition of the viscera; the patient also should be warned of the abnormality.

Dr. HERBERT SPENCER said he had been appealed to by Dr. Ford Anderson for his opinion on the direction of the twist of the cord. He had always accepted the teaching that the direction of the twist varied: but he had a feeling of shame that he could not definitely answer the question from his own experience. He hoped some young obstetrician would set the matter at rest by careful examination of the direction of the twist in stillborn children.

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Section of Odontology.

President—Mr. J. Lewin Payne, O.B.E., L.R.C.P.Lond., M.R.C.S., L.D.S.Eng.

The Origin and Growth of the Odontological Society.

PRESIDENT'S ADDRESS.

By J. Lewin Payne, O.B.E., L.R.C.P.Lond., M.R.C.S., L.D.S.Eng.

In perusing the records of recent years I find that very little has been said relating to the history of this Section or to the origin of the Society from which it sprang, and I have been told that the younger members of the profession are very imperfectly acquainted with the facts concerning the early days of dentistry and the difficulties which our predecessors had to face.

For my own part, I find it a source of great satisfaction to look back over the pages of the last eighty years to the time when the first steps were taken to organize our profession, and to observe the progress that has been accomplished in the interval, for from these early beginnings can be traced the present position and condition of dental surgery in this country, and its close relationship to medicine. Moreover, I am convinced that a retrospect is of value, because the history of the past shows the difficulties, as well as the mistakes, with which others have had to deal, and hope and inspiration for the work lying before us, will ensue. It has been very truly said by one of my predecessors in this Chair, that "the history of the Odontological Society is the history of the emancipation of dental surgery."

Less than a century ago the dental profession could not be said to exist, for the practice of dentistry had no status as such, and it was in a very deplorable condition.

No defined course of training was required from those who desired to practise, and most of this work was consigned to uneducated men, such as the barber, the village blacksmith or to men like "Thomas Smith, glazier, let Blood and Draw Teeth Tea Kittels & Potts Buckets Lantrens Cups to be Handled Heare," whose dreadful sign was presented to the Odontological Society as a gruesome relic of bygone days.

Although the profession did possess a few men with special knowledge of its art and science, and some who were qualified medical men, a very small proportion of those in practice made any attempt to uphold its dignity as a profession. Even members of the Royal College of Surgeons who described themselves as consulting dentists were not above issuing pamphlets advertising their skill.

It was John Hunter who, in this country, first drew special attention to dentistry as an important branch of surgical practice. The beginning, however, of organized effort to improve the status and the aims of dentistry in this country must be attributed to George Waite, a member of the Royal College of Surgeons, who, in 1841, issued "An appeal to the Parliament, the Medical Profession, and the Public, on the present state of Dental Surgery." He was a dentist of repute, both in this country and abroad; and Parmley, a well-known American dentist of that period, spoke in glowing terms of his beautiful gold fillings, the like of which he had not before seen.

George Waite urged the necessity of recognizing dentistry as a legitimate branch

of medicine, and he suggested that the College of Surgeons should nominate a Board from the dental members of the College, which might issue diplomas to those dentists who showed competence at an examination. This appeal voiced a desire for reform which was felt very strongly amongst some of the most eminent practitioners of dentistry, but there was not enough enthusiasm amongst them to secure any organized effort, and nearly twenty years passed before this reform was achieved.

During the following year (1842), James Robinson, who, at a later period, took a leading part in the formation of the College of Dentists, and also in the foundation of the National Dental Hospital (1861), endeavoured to form a Dental Society, but the scheme was abandoned.

On March 4, 1843, whilst a Bill affecting the medical profession was before Parliament, a meeting was called at the house of Arnold Rogers, in Regent Street, to consider the claims of dentists. Messrs. Robert Nasmyth, John Tomes, Edwin Saunders, Charles Stokes, George Parkinson and Dominique Morrell attended, and Arnold Rogers occupied the Chair. It was decided at this meeting to inquire of the President of the Royal College of Surgeons of England whether the Bill before Parliament had any reference to dental practice, and, if not, whether it could be so amended as to include dentists in its provisions.

The President of the Royal College of Surgeons (Anthony White) was interviewed, but he was not very encouraging, either in his remarks or in his reply to the deputation, and he described as "seceders" those members of the College who practised dentistry exclusively.

Thomas Bell, the dental surgeon to Guy's Hospital, and a Fellow of the Royal Society, who had some influence at the Royal College of Surgeons, and whose scientific writings placed him in a position of responsibility, held aloof; for he insisted that every dental practitioner should become medically qualified.

Further meetings were held and petitions were presented both to the President and Council of the Royal College of Surgeons and to the Secretary of State for the Home Department, who had charge of the Medical Bill. But, in spite of several valiant efforts by those high-minded practitioners, for more than ten years little was accomplished towards redeeming dentistry from its unsatisfactory position.

Failing in his effort to form a dental society, James Robinson, in 1843, started the first periodical published in Europe which was devoted exclusively to dental surgery. It was entitled *The Quarterly Journal of Dental Science*. This journal had a very short life. It was followed by another publication called *The Forceps*, which lasted from 1844 to 1845.

In 1847 John Tomes (as he was then) completed the publication in the *Medical Gazette* of his lectures on "Dental Physiology and Surgery," which had been delivered at the Middlesex Hospital Medical School in the year 1845, and this work was perhaps the most important matter that affected the profession for the next few years. Sir John Tomes was a man of extraordinary ability and energy; revered throughout the world wherever dentistry was practised, he was the guiding spirit that inspired the dental reforms of the last century. The members of the Odontological Society elected him as their president in 1862 and again in 1875. He died in 1895.

On August 25, 1855, there came from Samuel Lee Rymer, then a young man of courage, skill, and zeal, a letter which was published in the pages of *The Lancet*. He described the subversive conditions under which dentistry was commonly practised, and appealed for the foundation of an independent "College of Dental Surgery."

The letter created a fresh interest in dental reform, and, after using the columns of *The British Journal of Dental Science* to carry on his propaganda, Rymer called a meeting at the London Tavern, Bishopsgate Street, E.C., on September 22, 1856, to consider what should be done. This was an important date in the history of British dentistry, for it was the first occasion on which all members of the profession had

been invited to meet together, and about two hundred dentists attended. Resolutions were passed calling for the organization of a dental society and the establishment of some system of professional education and examination. A committee was then appointed to carry these resolutions into effect.

In the meantime, the gentlemen who first approached the Royal College of Surgeons with a memorial in 1843 had not been indolent, and in November, 1855, a meeting was convened for the purpose of founding a society on an equality with other learned societies.

Whilst this question was under consideration, it was decided to memorialize the Royal College of Surgeons once more on the necessity of establishing a recognized dental qualification. In this second memorial it was urged that some special

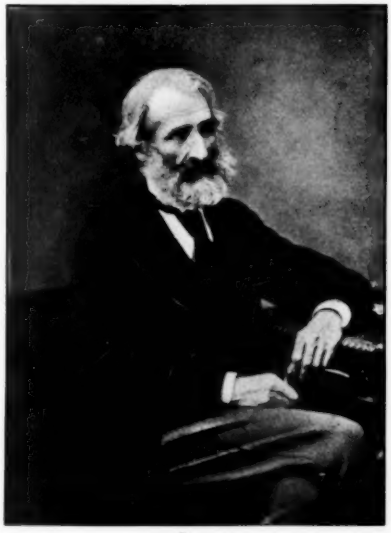


FIG. 1.—Sir John Tomes, F.R.S., F.R.C.S.Eng.

qualification in dentistry was required. Although a few of those who practised dentistry had obtained medical qualifications, the memorialists explained that a strictly medical or surgical degree could not, in itself, prove that the possessor was familiar with the practice of dental surgery. They petitioned for a course of education, to be followed by an examination, in the department of dental surgery, on similar lines to that of midwifery.

This second memorial was signed by eighteen of the leading dental practitioners of that day, and it was presented to the President and Council of the Royal College of Surgeons on December 11, 1855. Whilst the matter was in abeyance the memorialists met at the house of Samuel Cartwright, Sen., 32, Old Burlington Street, on October 27, 1856, and again on November 10, 1856, when they duly constituted themselves "The Odontological Society of London," a society for the encouragement of a knowledge of dental surgery.

The by-laws were founded upon those of the Pathological and other learned societies.

The following officers were appointed :—

President : Samuel Cartwright, F.R.S.
Vice-Presidents : John H. Parkinson ; Arnold Rogers.
Treasurer : Edwin Saunders.
Hon. Secretaries : Samuel Cartwright, Jun. ; John Tomes ; Thomas A. Rogers.

The meetings were fixed for the first Monday in each month, excepting September and October. The entrance fee was £10 10s., and the annual subscription, £1 1s. The emblem chosen for the Society was the profile of John Hunter, encircled by a garter bearing the inscription "Odontological Society" (fig. 6, p. 10).

Thus, a struggle had been in progress during the year 1856 between the memorialists (as they were called), who continued their methods of privacy, and the party led by Samuel Lee Rymer, which invited the co-operation of all those who were

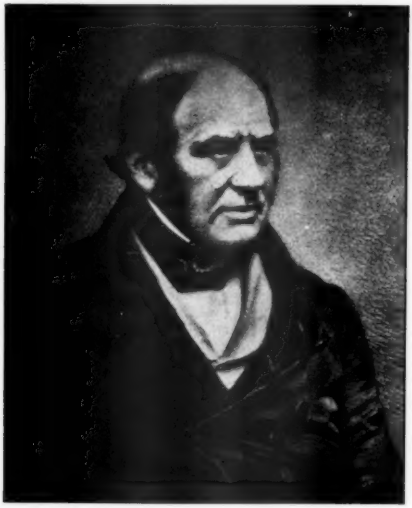


Fig. 2.—Samuel Cartwright, F.R.S.

practising dental surgery in the country, and which was in favour of establishing an independent college that should grant its own diploma.

The fact that some of those who were amongst the most influential members of the profession did not act in unison with the great bulk of practitioners led to resentment. These feelings were accentuated when, at the second meeting for the organization of the profession on Tuesday, November 11, 1856, it was discovered that the Odontological Society had been constituted on the previous day.

On Monday, January 5, 1857, a small number, less than fifty members, assembled in a room at 32A, George Street, Hanover Square, W., to listen to the inaugural address of Samuel Cartwright, Sen., the first president of the Odontological Society of London (as it then was called). Samuel Cartwright held no medical qualification, neither had he any dental diploma, as these were days before the Licentiateship in

Dental Surgery was instituted, but he possessed the higher distinction of being a Fellow of the Royal Society.

In the course of an able and eloquent address, he reviewed the position and prospects of dental surgery and spoke strongly in favour of a liberal education and of the importance of maintaining a close connexion between dental and general surgery. He declared that the professions were too closely allied to be separated, and that a voluntary separation from the College of Surgeons would be disastrous to the best interests of the speciality. After the meeting the members adjourned to the house of Edwin Saunders, at 13A, George Street, Hanover Square, for a conversazione.

From these small beginnings the Odontological Society began to enrol the best and most distinguished members of the dental profession.

One of the first of the practitioners from the provinces invited to become a member was J. R. Mummery, then living at Castle Street, Dover. He was the

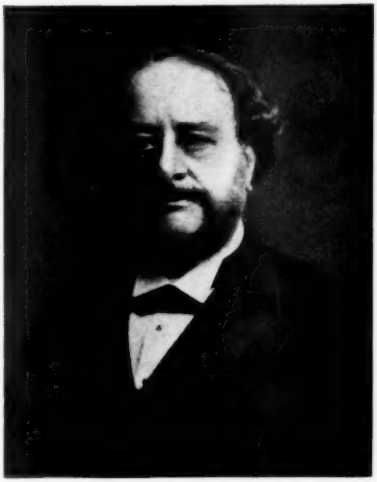


FIG. 3.—Sir Edwin Saunders, F.R.C.S.Eng.

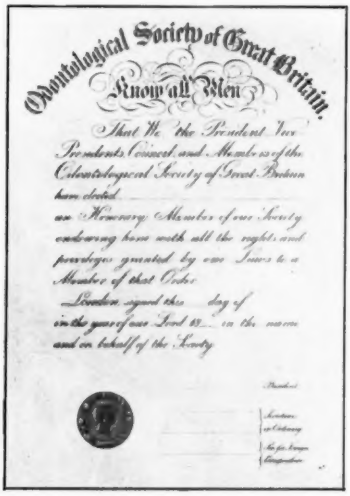
honoured father of Mr. J. Howard Mummery, who has done signal service in dental research during the last half century.

Before the end of the first year the Society had added to its supporters some forty to fifty members, and had reached a total of ninety-one. In 1858 the number was 174. Thenceforward the Society gradually increased its influence, not only in the profession but also among the members of other learned societies.

Two items of interest in connexion with the early years of the Odontological Society may be noted. One was the engraving of a diploma for presentation to the honorary members of the Society, and the other was the share taken by the Society in the memorial to John Hunter, which was erected over the grave at Westminster Abbey after his body had been re-interred there. A sum of £50 was contributed by the Society towards this memorial. Both these events occurred during the year 1859.

In the meantime, and as a result of the meetings called by Samuel Rymer, "The College of Dentists in England" had been founded under the presidency of James Robinson, with Charles James Fox, Alfred Hill, and Samuel Lee Rymer as honorary secretaries.

The inaugural meeting of the College was held at the Hanover Square Rooms on February 14, 1857, about five weeks after the first general meeting of the Odontological Society. To that meeting members of the Odontological Society were invited, and cards of invitation were sent to S. Cartwright, Jun., one of the hon. secretaries, for distribution amongst the members. But Cartwright returned the cards stating that the secretaries had not been authorized to issue them. This appears to have been done without consulting the Odontological President or Council, and naturally it caused some resentment amongst the members of the College of Dentists in England.


Odontological Society of Great Britain.

Know all Men

That We the President Vice Presidents Council and Members of the Odontological Society of Great Britain have elected

an Honorary Member of our Society entitled to enjoy with all the rights and privileges granted by our Laws to a Member of that Order

Given under our hand this day of in the year of our Lord 18 in the name and on behalf of the Society

President

Secretaries

FIG. 4.—Diploma for presentation to Honorary Members of the Odontological Society.

It would not be profitable to go into the various events and the somewhat acrimonious discussions which followed between these two parties. But this at least can be said: both quite sincerely believed that they were working for the best possible results; both parties were quite earnest and held the future of our profession at heart. It is enough that the dreams of these pioneers have come true.

Although the Royal College of Surgeons had been petitioned thrice before the end of 1856, they sent no official reply, and in February, 1857, it was decided to appeal once again to the President and Council. It was not that the College authorities were entirely unsympathetic with the aspirations and ideals of the memorialists, although a large proportion of dental practitioners thought otherwise, and this view has been suggested by Alfred Hill in his "Reform in the Dental Profession." In the early stages, no doubt, some members of the Council of the Royal College felt reluctant to take upon themselves the responsibility for a speciality which at that time was of small repute and little appreciated, and for the

acquirement of which no recognized educational system existed. The real difficulty, however, was explained in a reply dated March 13, 1857, from Edmond Belfour, the secretary. It was that the Council of the College of Surgeons had not the power to institute a special examination in dental surgery without the authority of a supplemental charter; and the Council thought it would be better if the Odontological Society made a direct appeal to Parliament to be placed, either independently, or in connexion with the College, under the supervision of the General Council proposed in a Bill which was being promoted by the various medical corporations.

The correspondence between the Odontological Society and the Royal College of Surgeons continued. The Odontological Society undertook to draw up a curriculum suitable for a licence in dental surgery. The Society disagreed with the suggestion of the Royal College that the examination of practitioners of dental surgery should be the same as that required for membership of the College, because that meant that a dentist would be obliged to spend longer over his education than the medical practitioner. They suggested a course of education extending over four to five years, and an examination which was not to be inferior to that of medicine.

It was to be different in *kind* but not in *degree*.

CURRICULUM SUGGESTED BY THE COUNCIL OF THE ODONTOLOGICAL SOCIETY.

Studies at General Medical Schools.

Two courses of Anatomy with Dissections.
" " Physiology and Pathology.
One course of Practice of Physic.
" " Surgery.
" " Materia Medica.
" " Chemistry.
" " Practical Chemistry.

Hospital Attendance.

Twelve months' Surgical Practice.
Six months' Medical Practice and attendance at Clinical Lectures.

Two Years at a Recognized Dental School or at a Dental Department of a Recognized General Hospital.

Two courses of Dental Anatomy and Physiology, Human and Comparative.
" " Dental Surgery.
" " Mechanical Dentistry.

One course of Metallurgy, also three years of Practical Dental Mechanics under instruction of a recognized practitioner.

In order to carry out the special training necessary for a dental practitioner, some new provision had to be made, and so the Council of the Society appointed a committee for the organization of a dental hospital and a school of dental surgery.

This organization involved a large amount of energy, and some of the members of the committee were indefatigable in their efforts. After a few months' strenuous work the Dental Hospital and London School of Dentistry was opened in Soho Square, on November 1, 1858. The building chosen for the purpose was No. 32, a quiet house in the south-west corner of the Square. Here the work of the first dental hospital of London was begun, and carried on for nearly sixteen years. The house stands there to-day, having suffered little alteration to its frontage during the last hundred years.

Formerly the house was occupied by Sir Joseph Banks (1744-1820), the great naturalist and President of the Royal Society. Now it is in the hands of an antique furniture dealer.

The Odontological Society, which had held its general meetings from the outset in the rooms of the Medical Society of London, at 32A, George Street, hereafter made

the new Dental Hospital its headquarters, and the first meeting was held in Soho Square on January 8, 1859, just two years after its inaugural meeting.

The drawing up of a curriculum for the training of dental surgeons and the founding of the first dental hospital in this country were not the only matters of importance to the profession which were undertaken by the Odontological Society during the year 1858. For the Medical Profession Bill, which had been introduced to Parliament in 1857 but withdrawn at the end of the session, passed through all its stages and became law in the summer of 1858, and the Society worked hard to obtain the inclusion of a clause to enable the Royal College of Surgeons of England to carry out the wishes of the memorialists.

Thus, with a suitable curriculum and a dental hospital and school in which to train students, the College of Surgeons was appealed to once more, and this time the

Fig. 5.—Dental Hospital and London School of Dentistry, Soho Square.

appeal was successful, for on September 8, 1859, an amended charter was granted to the Royal College of Surgeons of England in the terms of the following clause :—

"It shall, notwithstanding anything herein contained, be lawful for Her Majesty by Charter, to grant to the Royal College of Surgeons of England power to institute and hold examinations for the purpose of testing the fitness of persons to practise as Dentists who may be desirous of being so examined and to grant certificates of such fitness."

This clause was added to the Amending Bill, and it may be considered, therefore, the Dental Surgeon's first Charter.

On March 13, 14, and 20, 1860, the first examination for the Licentiateship in Dental Surgery was held, and forty-three gentlemen obtained the Diploma. The Examiners appointed by the College of Surgeons were Messrs. Arnott and Lawrence for the general subjects, and Messrs. Thomas Bell, Arnold Rogers and John Tomes for the dental subjects.

The next important stage in the history of the Odontological Society was its union with the College of Dentists, which occurred on May 4, 1863. Within a year

after the formation of the College of Dentists an attempt was made to bring the two organizations together. Thomas Underwood, the grandfather of our esteemed Hon. Secretary, who at that time was a prominent member of the College of Dentists, worked hard to achieve this result. He met John Tomes, and together they drew up an agreement which would have led to an amalgamation in 1858.

This draft agreement was supported by many of the most able and influential members of the College of Dentists, of whom James Robinson and Robert Hepburn were chief. But the antagonisms which had arisen earlier prevented this first attempt from reaching a successful issue, and when a vote was taken at a general meeting of the College a small majority decided against the union. After this the College of Dentists lost ground, for Thomas Underwood and many other members of the College joined the Odontological Society and threw their influence into what had been formerly the smaller body.

After this unsuccessful attempt to settle the difference of the two parties, the College of Dentists adhered to its original intention of conducting its own teaching and granting its own diploma. So the Metropolitan School of Dental Science was formally opened at 5, Cavendish Square, on October 5, 1859.

Stimulated by the action of the Odontological Society, and mainly through the influence and energies of James Robinson, the National Dental Hospital was opened in November, 1861.

There were at this time two contending parties, each possessing a School and a Hospital. Each published Transactions in its own Journal. But the action of the College of Dentists at its General Meeting of January, 1858, in refusing to join hands with the Odontological Society, led to the secession of some of the College's most notable supporters, and Samuel Rymer's party discovered that it was losing ground, whilst the Odontological Society was gaining all the time. And so, in December, 1862, after an independent existence of just five years, they approached the Odontological Society, and after formal dissolution on April 6, 1863, the majority of the members joined the Society which thenceforward was known as :

THE ODONTOLOGICAL SOCIETY OF GREAT BRITAIN.

The College handed over its library, museum, furniture and such small funds as were available after the winding up.

Thus, in May, 1863, the College of Dentists ceased to be, and the rivalry between these two contesting parties of the profession came to an end.

The political work of the Odontological Society, however, did not end with the establishment of a dental diploma and the amalgamation with the College of Dentists. For, whilst the Charter had given the Royal College of Surgeons power to examine and grant a Dental Diploma it did not provide for the registration of the L.D.S. For some years the Society agitated for this further recognition, but it was not until the passing of the Dentists Act of 1878 that registration was granted.

After the Dental Reform Association had been established as a separate organization by leading members of the Odontological Society in 1876, the British Dental Association undertook the political propaganda and left the Odontological Society free to devote all its energies to scientific work.

When the Dental Hospital of London, finding that the house in Soho Square was becoming too small, moved to larger premises at 40, Leicester Square, in 1874, the Odontological Society moved also, and it found in the new building much better accommodation for its library and museum, as well as a more suitable meeting-room.

Twenty-five years later the Royal Dental Hospital of London needed further accommodation, and new premises at the corner of Leicester Square were erected. Then it was that the Odontological Society severed its ties with the hospital and moved into the premises of the Royal Medical and Chirurgical Society, 20, Hanover Square, W.

The number of members increased year by year, until in 1906 the total had reached 416. Its position amongst other medical and scientific societies was enhanced, and it contained distinguished names such as those of Professors Owen, Huxley and Flower, on its roll of members.

About twenty years ago, whilst steps were being taken to bring about a union of the various medical societies in London, the Odontological Society of Great Britain was invited to join, and, as you all know, after deliberations extending over about two years, the Royal Society of Medicine was formed, and the Odontological Society became the Odontological Section of that union of medical societies. In this union are enjoyed many opportunities which could not have been offered by a smaller society to its members. This Section also possesses special privileges, which were granted solely because of the library, the museum, and the substantial funds brought into the union.

The library has become a part of the largest medical library in the British Empire. The museum was removed to the Royal College of Surgeons in 1909, where it is now housed for us and forms another link in our association with that body.

Thus I have endeavoured to show what an important part the Odontological Society has played in the early history of our profession. It was the first society of dental practitioners formed in this country. It drew up the curriculum which has formed the basis of education for the dental surgeon ever since. The Odontological Society was mainly instrumental in founding the first Dental Hospital in this country. Its persistent appeals led to the establishment of the L.D.S. diploma of the Royal College of Surgeons, and some of its leaders took an active part in the drafting of the Dentists Act of 1878, and afterwards they laid the foundations for the establishment of the British Dental Association.

In conclusion there is one other matter to which I should like to call special attention.

Up to the time that the Odontological Society became a Section of the Royal Society of Medicine the membership had been steadily increasing, and, as already stated, in 1906, the year before the amalgamation was completed, the total had reached 416. Since that date, in spite of the fact that there have been year by year a larger number of dental practitioners eligible, our membership has gradually decreased.

In 1920 it had dropped to 313 and to-day it is less than 300.

Instead of gaining in strength, it has lost. This makes one pause, and wonder whether, because some of our independence has gone, we have also lost some of our individuality, ideals, and enthusiasm. Let me urge the Members to seek new adherents with the keenness displayed by those who orginally founded the Odontological Society. I hope, in the account given of its origin and growth, and the references to the men who threw all their energies into the welfare of their profession, that you may have gained some inspiration and incentive to " go and do likewise."

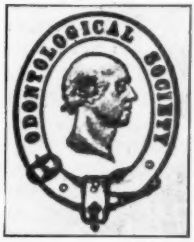


Fig. 6.—Emblem of the Odontological Society.

Section of Odontology.

President—Mr. J. Lewin Payne, O.B.E., L.R.C.P.Lond., M.R.C.S., L.D.S.Eng.

A Melanotic Epithelial Odontome in a Child.

By J. Howard Mummery, C.B.E., F.R.C.S., L.D.S., and A. T. Pitts, D.S.O., M.R.C.S., L.D.S.

Katherine W., aged 5½ months, was admitted to the Hospital for Sick Children, Great Ormond Street, in September, 1921, under the care of Mr. T. Twistington Higgins, F.R.C.S., for a swelling of the maxilla.

History.—According to the mother the swelling appeared in the front of the maxilla at about one month and had steadily increased in size. The baby had been fed on modified cow's milk. Its general condition was good and it did not appear to be affected by the tumour.

Examination.—The child was well nourished and apparently free from any pain. The tumour was situated on the anterior aspect of the maxilla in the incisor region, chiefly on the right side but extending to the left side also. It was about the size of a small walnut and pushed forward the upper lip (fig. 1). The mucous membrane was stretched over the tumour but was freely movable. The tumour felt uniformly

Fig. 1.

hard though not bony. It did not seem to be tender and there were no signs of inflammation. There were no teeth present on admission but during the child's stay in hospital previous to the operation the right upper deciduous central appeared. The labial surface presented through the gum, and it was evidently not a case of normal eruption but due to the growth of the tumour. A radiograph, unfortunately lost, showed that the tumour cast a moderately dense shadow much less dense than bone. There was a dense patch on the left side, evidently calcified, which resembled the imperfectly-formed crown of a tooth. There was no sign of the outer alveolar plate in the radiograph. Mr. Higgins asked one of us (A. T. P.)

to see the case with him in the ward. It was agreed that probably the tumour was an odontome, though the exact variety was uncertain.

Operation.—October 21, 1921. The child having been anæsthetized, a flap of the stretched mucous membrane was raised over the tumour. It was found that the outer plate had been thinned to the consistency of tissue paper over the growth, but that it was still complete. Its thinness accounted for its apparent absence in the radiograph. This bone was removed as well as the thicker bone over the lateral margin of the tumour, so as to give access to the growth. It was found to be non-adherent to subjacent tissues except on its deep aspect. Here it was intimately united to the bone, spicules of which passed into its substance, and some force was needed to dislodge the tumour. The cavity was obliterated to some extent by crushing in the expanded bone, and the flap of mucous membrane was sutured into position with catgut. Recovery was uneventful and the child was discharged from hospital eleven days later.

Subsequent History of the Patient.—The patient was seen again by one of us (A. T. P.) in conjunction with Mr. Higgins a year later. The child was in perfect health and there was no sign of local recurrence or of metastasis. In view of the microscopic appearance of the tumour, to be described presently, an examination was made for pigmented patches in the mouth and elsewhere on the body but none were found. The teeth then present were $\frac{D\ \ B\ \ |\ A\ B\ \ D}{B\ A\ |\ A\ B}$. $\underline{B}|$ was twisted but well formed. The left incisors were in perfect alignment.

The child was again examined last week (October 21, 1925). She is now 4 years 6 months. She is a well developed, healthy child. All the deciduous teeth are present with the exception of the right upper central incisor. None of the permanent

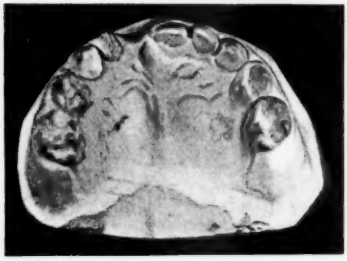


FIG. 2.

FIG. 3.

teeth have erupted. $\underline{B}|$ is twisted through a right angle with the lingual surface looking mesially. The arches are regular and the occlusion normal. The scar of the operation is visible on the right side of the frænum, and the lip is slightly attached to the gum by several narrow strands of tissue. The anterior surface of the bone above the missing central was concave, and this suggested that the permanent right central was absent. Elsewhere in the incisor region the outer plate was convex, this appearance suggesting that the other permanent incisors were present (fig. 2).

Radiographs were taken at the Hospital for Sick Children, both films and an antero-posterior plate, and prints from these have kindly been made by the Sister-in-charge. They show clearly that the right permanent central is absent. The left incisors are present and appear to be in normal position. The right lateral is present but the shadow suggests that it is twisted like the deciduous lateral. No sign of any tumour is visible (fig. 3).

EXAMINATION OF THE TUMOUR.

The growth preserved in 10 per cent. formol was of a blackish-grey colour. It measured 25 × 16 mm. and was invested by a thin, non-adherent capsule, through which the calcified mass shown in the drawing and the radiograph could be distinctly seen (fig. 4). The calcified body had a general resemblance to the crown of an incisor tooth. In addition to the larger calcified mass the radiograph showed several small calcified bodies scattered throughout its substance. The tumour was divided in the coronal plane by a sharp Gillette blade.

The cut surface showed a narrow, irregular cortex of a pale colour with a central, much darker zone. This zone was nearly black, but not uniformly so, being stippled with black dots spreading towards the periphery.

A small calcified body was seen to be embedded in the cut surface. A scraping from this examined in a drop of Farrant's solution under the microscope showed it to be composed of osteoid tissue.

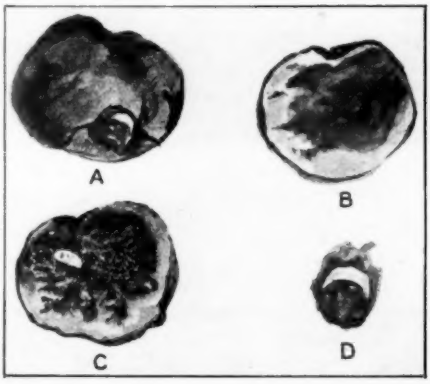


FIG. 4.—(*a*) Life-size drawing of the tumour; (*b*) coronal section through tumour; (*c*) coronal section showing distribution of pigmented area; (*d*) slightly enlarged drawing of the calcified mass of enamel on anterior aspect of the tumour.

Embedded in the outer surface of the tumour was a hard mass of what appeared to be enamel, of a yellowish-brown colour and mottled appearance, roughly resembling the crown of an incisor in shape and terminating abruptly above, where it was continuous with a semilunar-shaped mass of soft tissue of a whitish colour. When separated from the tumour this calcified body appeared to be a thin scale of enamel, and the soft tissue above it formed a sort of shallow sac beneath it reaching nearly to its exposed edge. As it appeared important to examine this shell without decalcifying (a process which would probably have destroyed it), it was cut on a freezing microtome, sections being taken in its long axis. Some fairly thin sections were obtained but the substance was decidedly hard and turned the edge of the knife.

Microscopic Appearance of Calcified Shell with Adjacent Tissue.

As was surmised the tissue turned out to be chiefly composed of enamel, very imperfectly formed. The prisms stained deeply both with van Gieson's stain and polychrome methylene blue. Intermixed with small masses of well-formed enamel were numerous calcospherites, and an enamel organ with ameloblasts, stratum

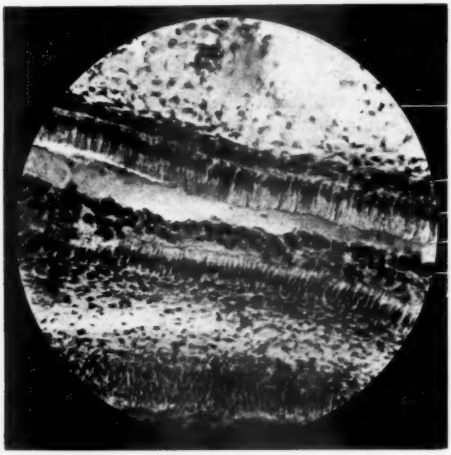


FIG. 5.—Folded enamel organ.

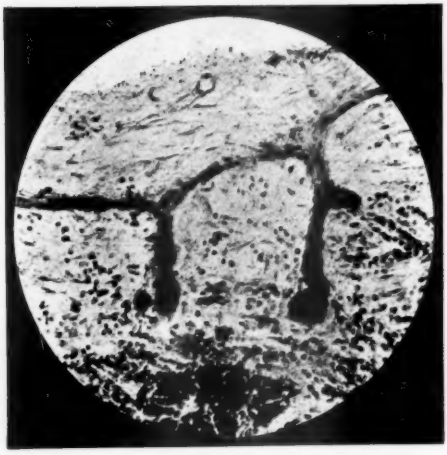


FIG. 6.—Epithelial band.

FIG. 7.—Showing globular enamel and malformed dentine (× 150).
(*a*) Enamel; (*d*) dentine; (*p*) papilla.

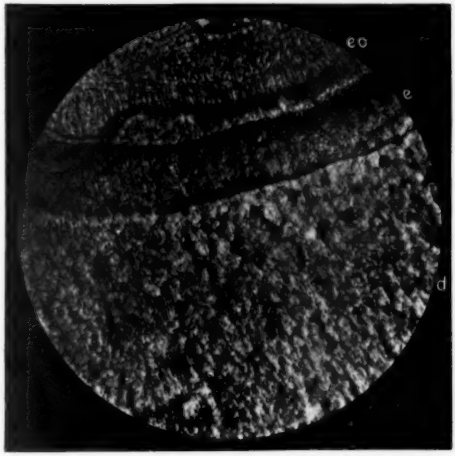


FIG. 8.—Band of enamel over globular dentine (× 150).
(*e*) enamel; (*eo*) enamel organ; (*d*) dentine.

intermedium and a stellate reticulum, was found in connexion with the masses of enamel. In several places long columns of enamel organ were seen extending into the growth with alternating bands of forming enamel (fig. 5). These bands of enamel-organ cells form five distinct layers, and in one section a prolongation of the enamel organ is seen within the dental papilla, and the enamel-organ cells form a circular investment to what appears to be a calcifying body.

In several sections a narrow epithelial band was seen at the margin with numerous buds of epithelium extending into the growth, bearing a striking resemblance to a tooth-band with young tooth-buds growing from it (fig. 6). Portions of dental pulp were also seen, as well as some imperfectly formed dentine. This was small in amount compared to the abundant enamel everywhere surrounding it, which was chiefly made up of masses of globular calcospherites. In the imperfectly formed dentine the tubules can scarcely be detected but they are clearly visible in the odontogenetic zone. The whole of the calcified dentine appears to consist of globules and interspaces, which latter take the stain deeply and under a low power give the impression of irregularly formed bony tissue (figs. 7 and 8).

Histology of the Soft Part of the Tumour.

This shows the typical structure of an epithelial odontome or multilocular cyst. There are numerous cystic cavities of all sizes, surrounded by connective tissue which forms strongly defined septa between the cysts (figs. 9, 10). These septa show strands of connective tissue fibres and spindle-shaped connective tissue cells. Clumps and strands of large epithelial cells traverse the connective tissue in every direction. These cells are ill-defined, being much obscured by the dark pigment which is visible both within and between them. The cysts are occupied by a mass of cells with small, round nuclei. Some of the cells are vacuolated and the whole contents of the cystic cavities are enclosed in a delicate network. In many parts this fibrillar network appears to be continuous with fine fibres in the connective tissue of the septa, and in many places it stains differently to the enclosed cells. The smaller cysts are surrounded by epithelial cells, which appear quite black from the contained pigment present in the cytoplasm but not in the nucleus. The larger cysts in most cases have no epithelial lining and the contents are in close apposition with the surrounding connective tissue. A similar condition has been noted by the authors of the "Report on Odontomes" (p. 13) [1].

There can be no question here of the loss of the epithelium from the lining membrane by manipulation, for the sections were placed in formol and cut on the freezing microtome and not exposed to the action of heat and alcohol. There is no pigment in the cystic cavities in most places, but in one or two instances the cysts, instead of containing degenerated cells in the fibrillar stroma, are filled with large epithelial cells which are loaded with pigment granules (figs. 11, 12).

Toward the periphery of the growth small clumps of apparently cornified epithelial cells are met with.

The tumour showed a distinct investing capsule of connective tissue. This is a point of some significance in view of the benign character of the growth as proved by the subsequent history of the patient. The pigment appears to be melanin. It does not react to the Prussian-blue test and is therefore not an iron-containing pigment. It is very abundant and gives a blue-black appearance to the central part of the tumour. The outer portion of the growth contains but little pigment, which appears to extend in radiating lines toward the circumference. There are a few small scattered particles of bone within the connective tissue.

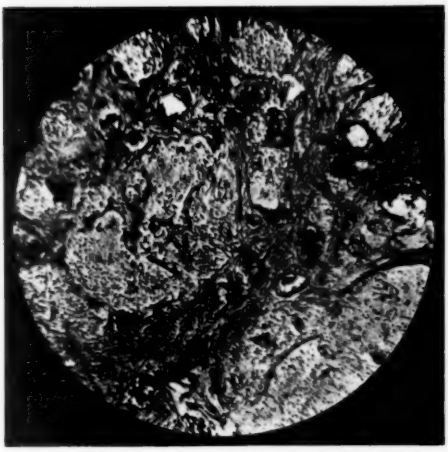


FIG. 9.—Alveoli and cysts (× 60).

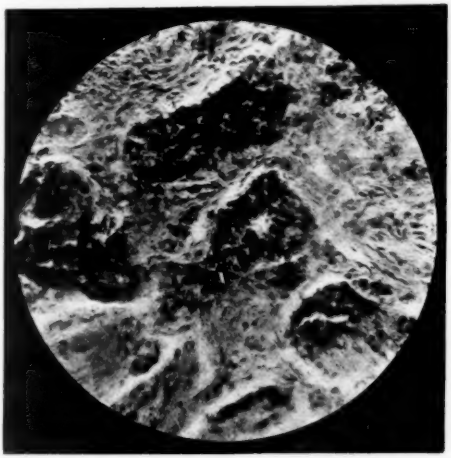


FIG. 10.—Alveoli with pigmented cells (× 150).

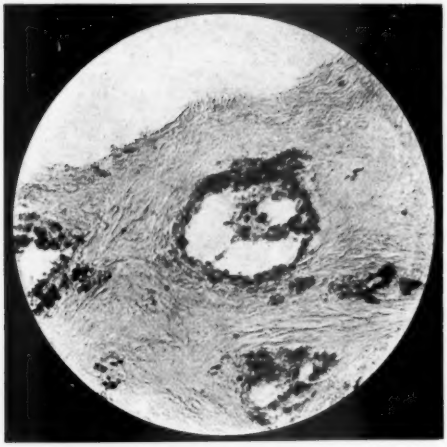


FIG. 11.—A small cyst lined with pigmented cells. Unstained preparation (× 150).

FIG. 12.—A portion of the cyst shown in fig. 9 (× 700).

COMMENTARY.

This tumour is of great interest both as a melanoma and as a dental tumour. Considered as a melanoma it appears, as far as we can find, to be the first on record in which melanin has been found in an odontome. Another striking point is that the tumour has been proved on clinical grounds to be benign, in spite of the high degree of malignancy often shown by melanotic tumours. It is true that melanotic tumours are not always malignant, as in many cases of pigmented mole, which are usually quiescent in character. When they begin to increase they are usually rapidly malignant, though exceptions to this rule have been recorded. In grey horses, in whom melanomas are especially common, they are less malignant than in man. For an actively growing melanotic tumour such as this to prove benign is uncommon. No suspicion of its melanotic character was entertained at the time of operation and no attempt at radical removal was made, so that had the tumour been malignant it would almost certainly have given rise to metastases.

Concerning melanin itself, it is an iron-free pigment unconnected with hæmoglobin and containing sulphur. It is found in the skin of negroes and is present in the eye. Scattered collections of pigment cells may also be present in the brain, along the course of nerves and in the retroperitoneal and mesenteric connective tissue.

Two views have been put forward as to their origin [2, 3]. One is that the chromatophore cells are specific mesoblastic cells, though epithelial cells may also take on pigment formation. The other view, for which there appears to be greater support, is that the chromatophore cells are, as their name implies, only carriers of pigment which is derived from epithelial cells, or melanoblasts, derived from the deeper layers of the skin. Under normal conditions the cells are quiescent and the pigment formation small. This applies to stationary melanomata. The melanin is cytoplasmic and not nuclear in origin. It has been noted that in a rapidly growing melanoma the division of cells is in advance of the formation of the pigment, so that some of the secondary growths are not pigmented; this may perhaps explain the comparative absence of pigment in the peripheral part of this tumour. Melanomata usually arise in places where pigment cells exist, though they have been found in places where pigment is not normally found. In this connexion it may be noted that in many dogs the palate is pigmented in patches. Mr. W. G. Spencer [4] also states that congenital patches of pigment may be present on the hard palate and inner aspect of the cheek in dark races, such as the Dravidian races in India. They have been stated to appear for the first time in middle life, and to spread. The structure is that of a quiescent melanoma. New and Hansel [5] have recorded twenty-four cases of melanotic cancer of the hard palate. Pigment cells are also present in the olfactory epithelium, and a few cases of melanotic cancer have been recorded in the nose. It is suggestive to find that melanomata have occurred in regions so close to the site of this tumour as the nose and hard palate. Whether the tumour was melanotic from the commencement, or whether it began as an odontome and became secondarily melanotic, one cannot say. The general characteristics of the growth suggest that it undoubtedly arose as an aberration of the dental epithelium, yet its melanotic characters are so well marked as to suggest that they were present from the outset.

Considered as an epithelial odontome the tumour is of great interest, for it is possible to link it up with other examples of epithelial odontomes, and we would suggest that it sheds considerable light on the genesis of these growths. Most cases of multilocular cysts have occurred in adults when they have attained a large size and it has been difficult to arrive at a conclusion as to their origin. Malassez [6] supposed them to arise from the paradental epithelial rests. Eve [7] and Heath [8] considered that they arose from a downgrowth of the gum. Falkson [9], Bryk [10],

and Bland-Sutton [11] considered that they arose from an abnormal development of the enamel organ. This latter view is now generally accepted and is supported by the structure of this tumour. It has been further stated that the origin of these tumours may be either from the cells of the tooth-band or from the various layers of the enamel organ, and that the nature of the cells in the growth gives a clue to the cells from which it has been derived. Thus, epithelial odontomes containing stellate cells like the stellate reticulum, or cubical cells like those of the tooth-band or the outer cells of the enamel organ, have been described. We would suggest that such an inference, based on the appearance of the cells in the tumour, is fallacious, and that because cells resembling those of the stellate reticulum are present in the tumour it does not follow that they are derived from the stellate reticulum. That they arise from an aberration of the tooth-band or from the forming enamel organ during its active life seems probable, but that the nature of the cells gives a clue to the exact origin of the growth appears to us unlikely.

The bulk of this tumour consisted of alveoli, some with a wide lumen, others almost solid with cells. In this respect it resembles other examples of epithelial odontomes, especially those arising in young individuals before the growth had attained a large size and still retained some of its embryonic characteristics. But at one part this tumour presents very unusual characteristics, namely, in the region of the flake of enamel embedded in its surface. In this region we find enamel of an amorphous character, which is arranged in layers alternating with rows of enamel organ not unlike the arrangement of the enamel in the lower incisors of *Galeopithecus*. We also find a curious appearance like a tooth-band with downgrowths of epithelial buds resembling enamel organs. The resemblance is so close that it is difficult not to believe that we have here an aberrant tooth-band, though not necessarily the tooth-band proper, with a series of aberrant tooth-buds. From this part of the tumour it is possible to trace the gradual development of alveoli of varying sizes, many of which are lined with epithelial cells and are often so crowded with cells as to appear solid. This suggests that the tumour originated in this region, which still retains the characters of the primitive dental epithelium and that subsequently it assumed the characteristic appearance associated with multilocular disease. Malassez remarks with regard to these tumours that the tubes and solid strands may represent the commencing forms of these growths, while the cysts are the end-products. In large specimens the alveoli may fuse together to form large cavities.

The view that the tumour originated in the region of the flake of enamel is supported by the subsequent dental history of the child. All the deciduous incisors are present, with the exception of the right upper deciduous central which had been pushed through the gum by the growth of the tumour and was removed at the operation. This tooth was in every way normal. This tumour could not therefore have arisen in substitution of one of the deciduous incisors. But a recent radiograph shows that the right permanent central incisor is absent and we therefore suggest that this growth may be regarded as having arisen as an aberration of the enamel organ of this tooth. As already stated, the growth was first noticed at the age of one month and must therefore have arisen earlier than that. The tooth-bud of the permanent central appears at the twenty-fourth week of intra-uterine life and calcification commences during the first year. The enamel organ was not destroyed by the growth but was stimulated to an abnormal activity characterized by an irregular formation of cells and the deposition of ill-formed enamel. The view has been put forward that multilocular disease may arise as a downgrowth of the gums or that the growths may be endotheliomata. Most of these growths were first noted when they had attained a large size and their embryonic characters had been obscured. The knowledge obtained from a study of these tumours in early life, when they are small, would seem to afford little doubt of their origin from the dental epithelium. In an account of an epithelial odontome in a girl of $4\frac{1}{2}$ years which was recorded before

this Section by Mr. Warwick James and Dr. Graham Forbes [12], the early age of the patient and the early state of the tumour clearly revealed the dental origin of the growth. In our case, in which the tumour arose at an age when dental development was in a still more active state, its dental origin is even better marked.

Two other small points may be noted. This tumour is true to type in occurring in a female. It is, however, a little unusual in being situated in the maxilla, for most cases of multilocular disease have been found in the mandible. It is remarkable that so large a tumour in so young a subject should have occasioned such a small disturbance of tooth development that the only trace of it is a torsion of a deciduous lateral and the absence of a permanent central. Though this tumour adds to our knowledge of the pathology of the epithelial odontomes, yet it is in many respects so aberrant that it must, we think, be regarded as something of a pathological curiosity.

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Section of Odontology.

President—Mr. J. Lewin Payne, O.B.E., L.R.C.P.Lond., M.R.C.S., L.D.S.Eng.

A Case of Exposure of the Dental Pulp of Uncertain Origin.

By G. B. Pritchard, M.R.C.S., L.R.C.P., L.D.S.

The short communication I am bringing before you to-night concerns a tooth which has been involved in a chronic rarefying periodontitis, and the results are confined to a very limited and sharply-defined portion of the posterior root.

The tooth is a lower right second molar, and on the distal surface of the posterior root is an absorption cavity, very much larger internally than at its orifice, communicating with the pulp-chamber of the root (fig. 1). The orifice is one-eighth of an inch in vertical diameter and rather less bucco-lingually, and its upper margin is one-sixteenth of an inch below the neck. In the recent state the pulp had liquefied, and had been dead at least three years before removal.

Fig. 1.—The specimen as it was removed in April, 1925.

Fig. 2.—Condition in July, 1922.

Fig. 3.—Condition in April, 1925.

It closely resembles those specimens, not uncommonly met with, in which the condition has arisen as a result of impaction of the third molar against them; but from the details I am about to give you it does not appear to have been caused in such a way.

The clinical notes are as follows, and up to January, 1923, when I first saw the patient, constitute only the history as obtained from the patient.

In July, 1921, the patient, a lady, then aged 30, had the third molar extracted after one week's history of pain. There were no complications and the operation was straightforward. It was stated that the tooth was very septic.

In July, 1922, the first radiographs were obtained (fig. 2).

In January, 1923, when I first saw the patient the tooth appeared normal except that the pulp did not react to thermal changes or to mechanical stimulation of the dentine. The gum-margin was intact all round the tooth and there were no symptoms of periodontitis. At this time the cavity had not been recognized.

In April, 1925, the patient complained of vague neuralgic pains in the region of the right ear, and, this tooth being under suspicion, further radiographs were taken (fig. 3). The gum-margin still appeared intact and there was no communication between the gingival trough and the cavity.

As to the length of time the cavity had been present I have no evidence, but from the slides prepared from radiographs taken in 1922 (July) and 1925 (April) it is evident that it had not increased in size materially during that time. It does not appear that there could have been any impaction of the third molar.

In the first place, the exceedingly good position of the tooth, in relation to the premolars, shows that it either erupted there after the premature extraction of the first molar, or moved there shortly afterwards. This must have left ample room for the third molar to erupt. The slide shows the space available. In the second place the slide of the film taken in 1922, a year after the extraction of the third molar, shows the anterior portion of its socket not completely obliterated, and in such a position as entirely to eliminate any possibility of its impaction.

[*January* 25, 1926.

Notes of a Complicated Removal of a Third Molar. Fatal Sequel.

By Walter Harrison, L.D.S.Eng., and E. W. Lowe, L.D.S.Ed.

The patient, a young lady, aged 26, presented herself to us on the morning of September 9. She complained of much pain and swelling on the right side of the mandible, discomfort having commenced about five days previously with increasing severity. Upon examination of the mouth we found a partially erupted, semi-impacted lower right third molar. The condition was inflammatory, but careful examination failed to reveal any pus. The examination was very difficult owing to great pain and tenderness, and almost complete inability on the part of the patient to open her mouth, the soft tissues being very badly inflamed and swollen.

After consultation we agreed that the removal of the offending molar was an urgent necessity. The mouth was syringed with hot water, and the patient dismissed with instructions to continue with frequent hot mouth washes until the afternoon, when she returned by appointment.

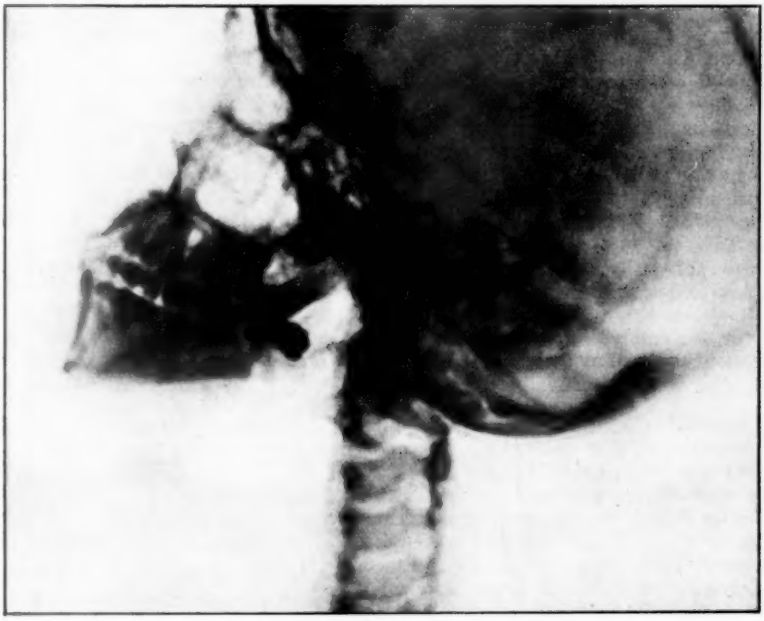
It was decided to attempt a regional anæsthetic; and 1½ c.c. of Waite's anæsthetic was given from a Waite's all-glass syringe. So great was the closure of the jaws that it was impossible to get the delicate barrel of the syringe between the teeth.

Anæsthesia was sufficiently established to enable the writers to begin the operation. It was impossible to apply forceps along the long axis of the tooth, and the attempt with that instrument was abandoned in favour of a straight elevator. With this we were successful in dislocating the tooth from the socket. It was thought at first that the tooth had merely risen in the socket, but exploration of the area disclosed the fact that complete dislocation had been effected. It was almost impossible to see, but eventually a glimpse was caught of the tooth lying in the soft tissues posteriorly to its natural position. It was fairly freely movable, but owing to it being very slippery the writers were unable to grasp it with any instrument.

Many other attempts were made to remove the tooth, but eventually all trace of it was lost; it could neither be seen nor felt, and, as there was no cough or interference with normal respiration, it was concluded that it had been swallowed.

The patient was dismissed with instructions to return the next day. She did not appear, and two days later, September 11, her medical attendant informed us by telephone that she was in bed, in great pain, and unable to come out. One of the writers visited her the same day and found the closure less severe, but exploration revealed no sign of the tooth. The socket was syringed on that day, and also on September 12 and 14; by that date the patient was up and fairly comfortable. The tooth had not been found in the excreta, but no essential importance, for many reasons, was attached to that.

Subsequently the writers heard from her doctor that the only discomfort was a certain tenderness in the soft palate. We asked him to bring the patient to us,



and eventually an appointment was made for September 26. The patient's doctor met the writers in consultation and a careful exploration of the area was made. The inflammatory condition had now entirely subsided. A suggestion made by one of us that an X-ray examination should be undertaken was discouraged by the doctor on the ground of expense, and in this he was seconded by the other of us who was still of opinion that the tooth had been swallowed, basing his conclusions upon the total absence of any symptoms, local or in the respiratory tract. A further consultation took place between the writers on September 28, and they decided for their own satisfaction to have a skiagram taken at the earliest opportunity, the date of which was October 6. The radiologist first screened the patient, without revealing the missing tooth. He then took a negative, which we saw on October 7; this

showed the tooth lying, with its apices forward, along the inner border of the angle of the jaw. The plate was shown to the patient's medical attendant the same morning and it was requested that a general surgeon should be asked to remove the tooth. This was arranged, and the operation was performed on October 16. There was a small fistulous opening in the soft palate; this was distended, the tooth being removed through the opening—the crown facing forwards and the roots backwards. The patient made a rapid recovery and was sent home the next day, October 17.

On October 20 one of the writers visited her and met her about to leave her house. She promised to call the next day, but did not do so, and this was the last time either of us saw her. On Sunday, October 25, the patient had two epileptiform seizures and was removed to a nursing home.

NOTES BY MR. PERCY SARGENT, C.M.G., D.S.O., F.R.C.S.

October 27.—Two days ago epileptiform attacks suddenly occurred. Patient recovered, but next day it was found that the left plantar reflex was extensor in type. The left leg rapidly became weak, and this was followed by weakness of the left arm, beginning at the shoulder and extending to the hand. Slight weakness of the left face. On examination, no voluntary power in lower left limb. Only finger and wrist movements possible in upper left limb. Temperature not higher than 100° F., pulse about 90. Patient bright, cheerful and showing no signs of meningitis. A diagnosis was made of embolism of the leg area with œdema around.

October 29.—Patient worse. Left arm now quite powerless. Face weaker. Temperature still not above 100° F. Pulse about 90. Headache severe. Vomiting. Cerebro-spinal fluid slightly turbid.

Operation.—The upper motor area was exposed on the right side. The general intracranial pressure was considerably raised. At the leg area the pre-central gyrus was pale, soft and broad. This was explored, but no pus was found. The operation was therefore converted into a simple decompression.

Report on Cerebro-spinal Fluid.—Turbid. Protein, 0·08 per cent. Chlorides, 0·69 per cent. Trace of reducing substance. Infecting organism not found.

Patient did well at first, but died in hyperpyrexia a few days later, November 2.

DR. GALT'S REPORT, OCTOBER 28.

I received a specimen of cerebro-spinal fluid for examination. The fluid was definitely turbid, but showed no flakes or naked-eye blood. The results of the detailed examination were as follow:—

Deposit.—Many pus-cells and one or two red blood-cells only.

Jenner Film.—Polymorphs, 92 per cent.; lymphocytes, 8 per cent.

Gram Film.—A fair number of Gram-negative diplococci were present; these were partly intracellular and partly extracellular.

Fehling's Solution.—Reduced fairly rapidly.

Albumin.—Present in fair amount.

Trypagar Cultures.—Sterile.

Pot. Permang. (1 in 1,000).—The fluid reduced five times its bulk of this solution.

NOVEMBER 2.—I received a further specimen, the naked-eye appearances of which were identical with the previous specimen. The results of examination were as follow:—

Deposit.—Many pus cells and a few red blood-cells only.

Jenner Film.—Polymorphs, 79 per cent.; lymphocytes, 21 per cent.

Gram Film.—A few Gram-negative diplococci present; these were all extracellular.

Fehling's Solution.—No reduction.

Pot. Permang. (1 in 1,000).—The fluid reduced five times its bulk of this solution.

Albumin.—Present in fair amount.

Trypagar Cultures.—Sterile.

Some Points in the Anatomy of the Capillary of the Tooth Pulp.

By A. W. WELLINGS, L.D.S.Ed.

The blood-vessels which enter the apical foramen of a tooth are said to terminate in a capillary plexus closely associated with the odontoblast layer. This association is undoubtedly in connexion with the metabolic activities of these cells and the constant supply of lymph to the dentinal tubules. The walls of the vessels, especially as seen in longitudinal section, are very delicate, and it is not easy to make out their structure.

Noyes says of them :—

"A very striking peculiarity of the blood-vessels of the pulp is the thinness of their walls. Even the large arteries show scarcely any condensation of fibrous tissue around them to form the usual adventitious layer, and usually contain but a single involuntary muscle-fibre representing the media, while the walls of even the large veins are made up of only the single layer of endothelial cells forming the intima, and are in structure like large capillaries."

Mummery also calls attention to their delicacy; he says :—

". . . the different coats of the arteries are difficult to detect, many even of the larger arterioles, appearing to possess an endothelial lining and a thin adventitia, but examination with high powers of the microscope and suitable illumination shows that a muscular coat is present although of great delicacy."

Broomell and Fischelis (1917) describe a longitudinal layer of thinly distributed muscular fibre on the vessels of the pulp. In a very complete description of the structure of the pulp-vessels Hopewell-Smith finds the usual three coats in the walls of the arterioles, and in the "tunica intima" external to the endothelial cells he describes some elastic tissue. There are well-defined muscular and adventitious layers with nerves present in the latter. The veins differ from the arteries in their larger size, a greatly reduced muscular coat, and in some variations in their endothelium. They are non-collapsible, and have no valves.

"The walls of the capillaries are made up of a single layer of endothelial cells, the smallest channels consisting of only two or three cells which are curved to form the exterior of the tube, the average diameter being about eight microns."

According to Fischer some of the larger capillaries possess a distinct adventitia, but it is very doubtful whether this author has not confused the smallest arterioles and venules with capillaries.

Distension of the capillary is said to occur mechanically by stretching of the cells when the volume of blood in the vessels is increased. When the pressure is relaxed the cells resume their normal condition and the calibre of the channel is reduced.

Until within a few years ago the accepted view of the capillary circulation was that blood is continually flowing through them at a rate determined by the state of contraction or dilatation of the arterioles. Consequently, the dilatation of an arteriole will cause a rise in pressure in the capillaries, which will become passively expanded, contracting again by their own elasticity when the pressure is relaxed. According to this view the capillaries have no power of independent action. Recent research, however, has proved that the capillaries of the human skin, for example, are able to dilate and contract independently of the arterioles. This independent action of the capillaries is due to the presence of certain cells on the capillary wall, which were originally described by Rouget in 1873 and are called after their discoverer "Rouget" cells. Rouget's work appears to have been entirely overlooked for nearly forty years, but recently Vimtrupp has succeeded in demonstrating certain nuclei on the outside of the capillaries differing slightly, but very distinctly, from the ordinary endothelial nuclei.

"The form of the nucleus varies with the state of contraction of the capillary. On a dilated capillary they are broad and very thin; by contraction they become narrower and thicker, their cross-section approaching the form of a circle.

". . . the protoplasm of the nuclei can only be made out by suitable staining, and even then it requires high-power immersion lenses and suitable lighting to demonstrate it clearly.

"The cells to which these nuclei belong are large branching cells, thickest around the nucleus, and thinnest towards the periphery of the cell where it tapers off into branching processes which encircle the wall of the capillary."

The changes in the endothelium under contraction and dilatation have also been studied, and it is found that in the dilated capillaries the edges of the rhomboidal endothelial cells are straightened, the cells are large, and their oval nuclei are level with the capillary wall, or project only very slightly on the inside of the tube. On contraction the cells are smaller, their edges sinuous, and the nuclei more rounded and project into the lumen of the capillary. On strong contraction the endothelium becomes still more folded. Summing up the results of Vimtrupp's investigations, it may be stated that the capillary wall, like the walls of the smallest arteries and veins, contains two elements, namely, the endothelium and the muscular coat.

The muscular coat in the larger vessels forms a more or less continuous layer, greatly increasing the thickness of the wall, and offering considerable resistance to the exchange of substances between the blood and the surrounding lymph spaces and tissue cells, whilst in the capillaries the muscular coat is arranged more or less in the form of a wide-meshed network, leaving the larger part of the capillary wall uncovered for the passage of substances through the endothelium with a minimum of resistance.

"The muscular coat of the capillaries possesses, like smooth muscles generally, a definite tonus, or posture," subject in the organism to nervous, hormonal, or other influences; and the diameter of the capillary is, on the whole, determined by the state of contraction of its muscular coat.

The passage of an arteriole to a capillary is marked by a short zone of transition in which the number of muscle-cells is reduced and the endothelium uncovered. Usually, however, there is a sharp demarcation between the muscular arteriole and the capillary, the distinctive feature of which is a large area of free endothelial surface in proportion to that covered by the contractile elements. The distinction between the capillaries and veins is much less pronounced.

The muscular coat of many vessels is so thin and incomplete that the exchange of substances through their walls must be considerable; and in some cases vessels which are anatomically classed as veins are, from a physiological standpoint, capillaries, possessing, in spite of their large size, a coating of Rouget cells instead of simple muscle-fibres, leaving the greater part of their endothelial surface uncovered. The sub-papillary veins of the human skin are such "giant capillaries," and the veins of the tooth pulp should probably be classed with them.

It has long been known that nerve-fibres accompany the capillaries. There are generally two fine non-medullated fibres, one on each side of the capillary, connected by a number of anastomoses crossing the capillary obliquely. Ganglion cells have not been found, and the actual connexions with the capillary wall have not been definitely made out. Sometimes a single nerve-fibre will pursue a spiral course along some portion of a capillary, in addition to (or instead of) the two comparatively straight fibres already mentioned. The nature of these fibres is not yet ascertained, but they are supposed to be sympathetic (fig. 8, p. 34).

In the larger vessels, especially in the arteries, there is a plexus of nerve-fibres with numerous cells which seem to be connected with the fibres. They are not ganglion cells, and are possibly the cells figured by Mummery on the walls of the pulp vessels. From this plexus branches are given off, forming a secondary plexus

inside the vessel wall, and it is possible that a nerve-net is formed by anastomosis of the fibres from which the muscle-fibres of the vessel are innervated.

It has been proved experimentally that the capillaries in many parts of the body are under sympathetic control; stimulation of the sympathetic fibres, for instance, running in the adventitial coat of the humeral artery causes a contraction of the capillaries at the base of the finger-nail in man. When examined microscopically under suitable conditions the contractions can be seen to start from the nuclei of the Rouget cells.

"There is reason to believe," says Krogh, "that every single Rouget cell is supplied from a sympathetic fibre and can be made to contract through it."

There is some considerable evidence that sensory nerve-fibres are concerned in the dilator innervation of the capillaries. In this connexion Mummery's demonstration of the relation of sensory fibres to the vessels of the pulp will be remembered, and although these fibres have not been proved to be sensory, since we know that the fifth nerve contains some sympathetic fibres, it would be in line with what is known of vaso-dilatation generally that sensory nerve-fibres should be concerned with this process in the pulp.

For examination of stained material, young, healthy teeth were used which had been extracted for regulation purposes. In some cases the teeth were decalcified, impregnated with silver by the Bielschowsky process and the stained pulps cut *in situ*. Those sections showing the relation of the nerve-fibres to the vessels, the flat nuclei of the Rouget cells outside the capillary wall, and the muscle-fibres encircling a small arteriole, were prepared in this way.

In other cases the tooth was cracked and the pulp removed from its cavity, fixed and embedded in paraffin cut and stained by various methods. One pulp of an upper premolar from which several of the photographs were made, was cut serially so that the vessels could be examined through the entire organ.

The general distribution of the vessels is as described in the text-books. At the apical extremity there are one or two main vessels which run up the centre of the tissue and several subsidiary vessels which may be cut transversely or obliquely. Very few capillaries are found here.

Passing up the pulp the number of vascular stems rapidly increases. The diameter of the vessels and the thickness of their walls varies greatly, some of the veins being scarcely more than channels or unlined spaces in the pulp tissue. In the middle third of the organ there are evidences of small vessels and capillaries right across the tissue (fig. 1, p. 31) but especially towards the odontoblast region, and the appearance of a vascular plexus towards the edge of the pulp is seen, from which the ultimate surface capillaries doubtless arise (fig. 2, p. 31).

It is well known that the capillaries are very numerous at the pulp surface (fig. 2, p. 31); one of the silver preparations under the microscope is taken from the extreme edge of the tissue and shows the capillary network very distinctly. But there are many running through the body of the organ to which I would call your attention. It may be mentioned in passing that the diameter of the largest vessels in the serially-cut pulp is as much as 200 microns, much greater than one would expect from the figures published as to the size of the pulp vessels. The diameter of the pulp capillaries varies greatly, and it is not always possible to distinguish a small arteriole and venule from a capillary. The points of difference are of course the absence of adventitia and continuous muscular coat from the wall; but since many of the pulp veins have these characteristics, they are classed as veins only from their size—they may well be included in the category of "giant capillaries" (fig. 3, p. 32).

The difficulty in distinguishing a capillary by its size is increased by reason of the fact that the calibre of the individual vessels varies greatly in its course. In the illustration (fig. 1) the width of the capillary in its narrowest part is ·005 mm., increasing

to as much as ·01 mm. at its widest. One might put the limits of measurement at from ·005 mm. to ·02 mm. The smallest would of course be too small for the passage of cells and would contain plasma. If it were possible to examine a pulp under different conditions, the number of capillaries visible would not be constant, many being closed under conditions involving sympathetic stimulation, or expanded under dilator impulses.

I desire to call your attention to the possibility of the presence of contractile cells —the so-called Rouget cells, on the walls of the small arterioles, venules and capillaries of the pulp. In many of the preparations examined I have found nuclei along the walls which are obviously not endothelial and which quite possibly are muscle-cells (figs. 4, 5, 6, pp. 32, 33). It must be remembered that one gets only a thin edge in section of what must be an expanded and flattened nucleus in the dilated vessel. In contraction the nucleus looks altogether rounder and smaller. The section here shown was sent to Professor Krogh, who replied that after careful examination both he and Dr. Vimtrupp (whom he spoke of as the " specialist on capillaries ") were of the opinion that the nuclei on the outside of the capillary were Rouget cells (fig. 7, p. 34).

I have not yet been able to complete the work, and should not at this stage have brought it to your notice, except that in a rash moment I had promised your President a paper, and it seemed not unpropitious to introduce a subject that must be of great importance in pulp metabolism.

The innervation of the vessels of the pulp has engaged much attention for some time past. You will remember an illustration in Hopewell-Smith's last edition of " Normal Histology " showing a nerve-fibre in relation to a vessel, and Mummery's beautiful preparations and drawings are also well known. The slide now exhibited (fig. 8, p. 34) shows some nerve-fibres in relation to capillaries. The relationship may be of course accidental, but the winding fibres here seen are exactly as described by Dr. Vimtrupp and are considered by him to be those supplying impulses to the capillary walls.

The question as to the nature of the nerve-fibres, whether they are sensory or sympathetic, has yet to be decided. Mention has already been made of Mummery's suggestions as to the possibility of the dilator mechanism coming from the sensory fibres, and, with the belief of most histologists of the present day, that nerves enter the dentine, it is possible to explain the profound circulatory changes that sometimes occur in the pulp in the early stages of disease of the dentine before infection of the pulp can have taken place. If contractile cells are present on the walls of the capillaries —and there is reason to suppose there are—they, like similar cells in other parts of the body must have a similar nerve control, each cell being supplied from a sympathetic fibre (Krogh). I am exhibiting a slide of a small arteriole which shows the presence of some circular fibres, probably muscle (fig. 9, p. 35).

In recapitulation, it is suggested that the capillaries of the pulp are not merely endothelial tubes which expand as the arterial pressure is increased, and contract when the pressure is reduced by their own elasticity; but that they, in common with the small arterioles and venules, have a contractile mechanism of their own. This mechanism consists of the presence of certain nucleated cells on the endothelial wall which, with their processes, encircle the wall. That contraction of the capillary commences at the nucleus of one of these cells which are innervated by sympathetic fibres.

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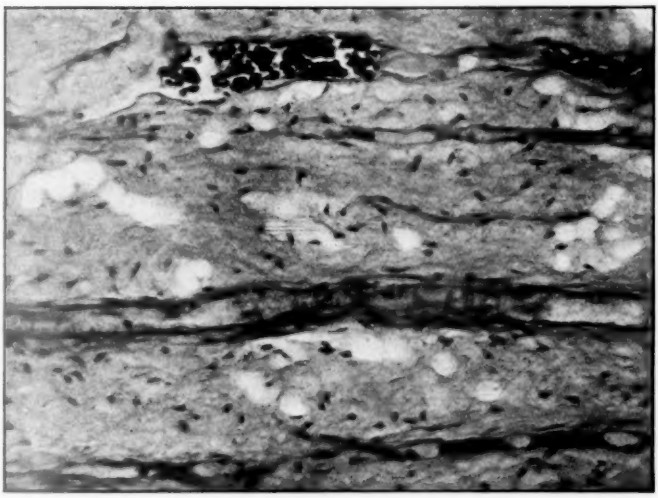

FIG. 1.—Venule, arteriole and capillaries from middle third of pulp. Note the differences in the calibre of the capillaries (× 300).

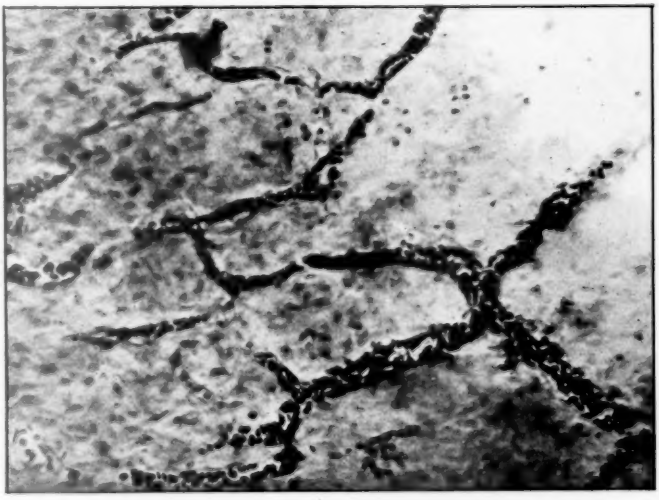

FIG. 2.—Capillary plexus near edge of pulp (× 300).

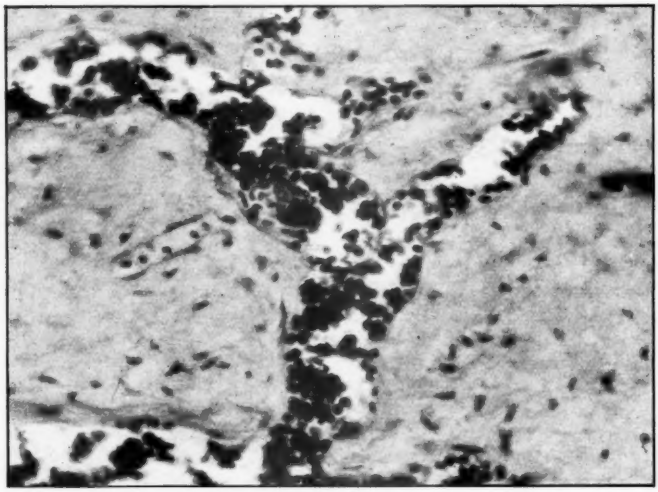

FIG. 3.—Large venule in the body of the pulp. "Giant capillaries" (× 300).

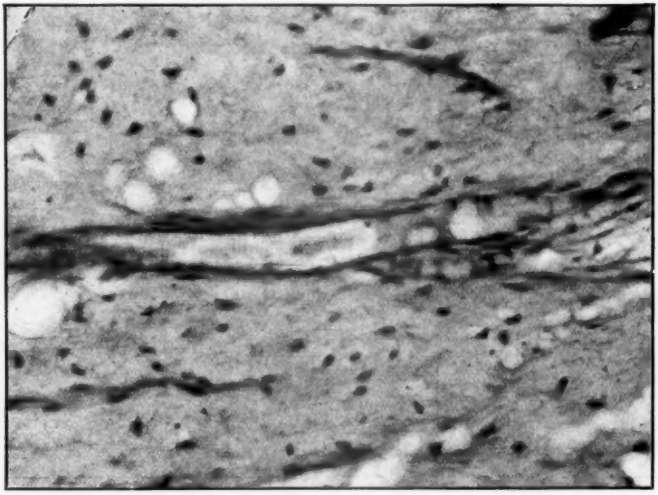

FIG. 4.—Nuclei on a small arteriole (× 300).

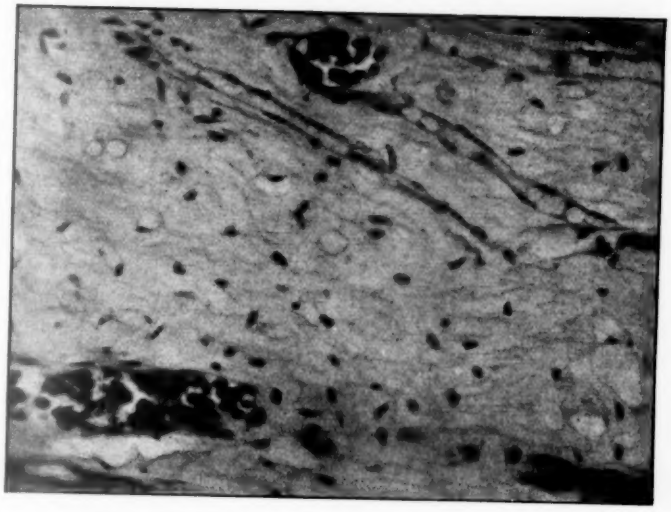

FIG. 5.—Small capillaries communicating with larger one (× 300).

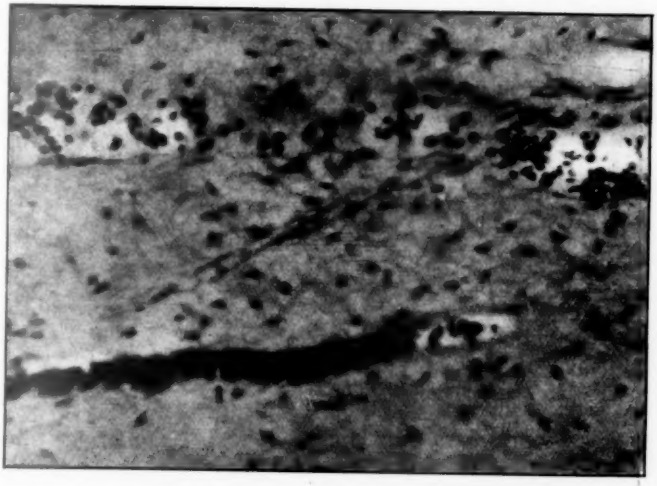

FIG. 6.—Vennle, arteriole and capillary (× 300)

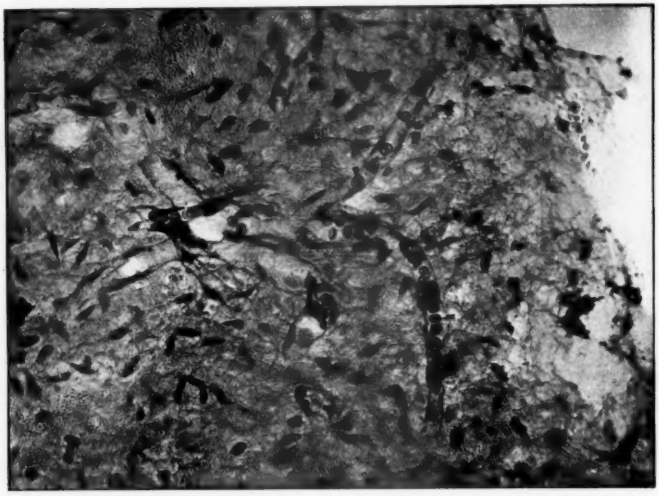

FIG. 7.—Illustrates the junction of two small capillaries to form a larger channel (× 300).

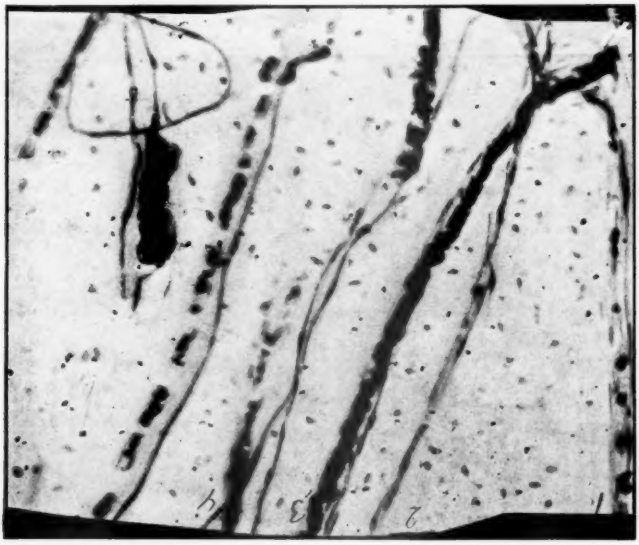

FIG. 8.—Nerve fibres in relation to the capillaries of the pulp. Nitrate of silver preparation, toned gold chloride, Bielschowsky process (× 200).

FIG. 9.—Fibres encircling a small vessel in the pulp, probably muscle fibres. Nitrate of silver preparation. Bielschowsky process, toned gold chloride (× 300).

Section of Odontology.

President—Mr. J. Lewin Payne, O.B.E., L.R.C.P.Lond., M.R.C.S., L.D.S.Eng.

Ivory Exostosis of the Mandible Simulating a Tooth.

By F. Coleman, M.C., L.R.C.P.Lond., M.R.C.S., L.D.S.Eng.

The subject of this communication was a woman about 70 years of age, who consulted me nearly four years ago for a swelling of the mandible.

History of the Affection.—For some months previously she had noticed that her lower jaw was becoming larger and that her denture was pressing unduly in the cheek sulcus.

Fig. 1.

Condition on Examination.—In the left molar region of the mandible there was a smooth, rounded swelling about the size of a small walnut presenting in the cheek sulcus. The bulk of the swelling was firm, but there was a fluctuating area over its surface; it was painless and the covering mucous membrane was normal and freely movable over its surface. Both jaws were edentulous and the patient was wearing complete dentures with springs.

Diagnosis.—I made a provisional diagnosis of cyst of the jaw and advised that the jaw should be radiographed. I was able to convince the patient that the condition was not serious and to dispel from her mind the suspicion she had as to its

malignancy. The radiograph was taken on the same day and revealed a dense mass over the body of the jaw resembling a large and inverted molar tooth (fig. 1). This mass was regarded by the radiologist and by myself as a displaced molar tooth, and I concluded that I had to deal with a dentigerous cyst. I advised the patient to have the cyst removed, and accordingly a week later she entered a nursing home.

Operation.—The patient was anæsthetized with ether and chloroform. An incision was made in the cheek sulcus over the swelling. Some fluid escaped, but less than I had anticipated, and the remainder of the operation was occupied in trying to dislodge what I had assumed to be a tooth. I first used a heavy pair of root forceps, but could get no movement in the mass, and the blades had to be opened very wide to enclose its bulk. I next tried lion forceps, and although a firmer grasp could be obtained with this instrument the mass was still immovable. I regarded my inability to loosen the tooth to be due to the fact that the broader portion was lying lowermost and I was trying to remove an inverted wedge. On this presumption I made an incision below the mandible and raised the soft tissues off its outer aspect until I came down on the mass. I then made further attempts with tooth forceps and lion forceps to loosen the mass, and although a firmer grasp could be obtained the mass remained absolutely immobile. This led me to suspect that I was probably dealing with an odontome or with an exostosis of the mandible, and as further attempts at removal proved futile I sutured the skin without drainage and dressed the wound.

FIG. 2.

After-treatment.—I visited the patient once or twice a day at the nursing home during the next two weeks. The mouth was irrigated at frequent intervals and the wound on the face was re-dressed throughout the day and night as soon as the dressings became contaminated. For two or three days following the operation fluids taken into the mouth leaked through the wound on to the face, and I had an anxious time in guarding against a cellulitis of the face and neck. The patient then left the nursing home, and when I saw her again a month later the wound on the face was still discharging slightly and bare bone could be felt with a probe. The wound in the mouth had healed. Another month later the patient resumed the wearing of her upper denture, and we arranged a skull and chin cap with elastic sides to retain the external dressing in position, as she was beginning to find the bandages around her head very irksome as well as being unsightly.

Two weeks later a loose sequestrum was detected under the skin and I advised the patient to see me in a week's time when I thought the sequestrum could be easily and painlessly removed. The sequestrum, however, anticipated me by a day, for on the patient's next visit she brought with her the sequestrum (exfoliated on the previous day), and to my gratification I found it comprised the entire bony mass (fig. 2). I saw the patient for the last time about a month later (i.e., four months from the time of the operation), the external wound had healed but had left a puckered scar which I trust time will efface. I now advised her to wear both

dentures, but if possible without springs, as these were rubbing against the scar in her cheek and might possibly have been a contributing, if not a determining, cause of the exostosis.

The fluid over the swelling was undoubtedly due to the constant friction of the springs over the smooth bony mass, and was formed much in the same way as fluid is formed in an adventitious bursa.

In November, 1909, I made a short communication to this Section on "Exostoses of the Mandible."[1] In the preparation of this paper I spent many hours in the Museum of the Royal College of Surgeons and examined a very large number of skulls, but certainly did not come across a bony anomaly such as the one I have just described, nor have I heard or read of a similar case. Ivory exostoses of the mandible usually run in two positions, viz., over the outer aspect of the angle of the jaw, where they form a nodular excrescence of dense bone, and on the lingual aspect (premolar region) of the mandible, where they are usually symmetrical, and may attain the size of a cobnut.

Abnormally-shaped Teeth from the Region of the Premaxilla.

By Sir FRANK COLYER, K.B.E., F.R.C.S.

THE Museum of the Royal College of Surgeons (Odontological Section) contains a good collection of abnormally-shaped teeth removed from the region of the premaxilla. These specimens have been re-examined and an endeavour made to arrange them in orderly groups, with the hope that by so doing one may be able to obtain a glimpse at the law or laws underlying their development.

Supernumerary teeth are usually divided into two main classes: (1) normal in shape, and (2) abnormal in shape. The latter class, usually subdivided into (*a*) conical-shaped and (*b*) tubercular shaped, is, I propose to show, capable of division into several groups which, although undoubtedly related the one to the other, nevertheless show some degree of discontinuity.

Group I.—The simplest form of tooth met with is conical-shaped (fig. 1 A). The root is single, as is the case with all supernumerary teeth from the premaxilla.

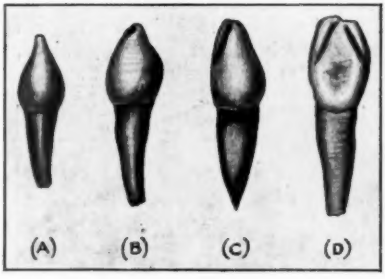

FIG. 1.

Types of supernumerary teeth.

The relative length of the crown and the root varies. The enamel usually ends with a straight margin. The conical-shaped tooth is the only type seen in the deciduous dentition. An examination with a magnifying glass will frequently reveal a pit in the apex of the crown.

Group II.—In this group a cusp is present on the mesial aspect of the tooth. In the simplest form it consists of a slight projection from the mesial side (fig. 1 B),

[1] *Proceedings*, 1909-10, iii (Sect. Odont.), p. 21.

while in some cases the projection rises to form the mesial border of the tooth (fig. 1 C). This type of tooth is common. The tooth shown in fig. 1 B was from the left premaxilla, that in fig. 1 C from the right premaxilla.

Group III.—We next pass to a type in which an additional cusp appears on the distal aspect and the tooth mimics the shape of a second incisor (fig. 1 D).

There is a model in the collection showing a stage in the development of the mesial and distal cusps. It is shown in fig. 2. The right tooth shows the primary cusp (*a*) and, anterior to this, two cusps (*b*) and (*c*); the left tooth shows a similar condition with the addition of an ill-developed cusp between the primary cusp and this distal cusp (*c*).

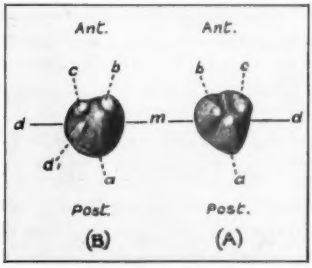

FIG. 2.

Drawing, from a plaster cast, of two supernumerary teeth, the one showing three cusps, the other four cusps. *Ant.*, anterior surface; *post.*, posterior surface; *m*, mesial surface; *d*, distal surface.

Group IV.—A bright light reflected on the palatal aspect of a maxillary second incisor will often bring into relief a shallow ridge, extending from the base of the tooth towards the distal aspect of the median cusp on the occlusal margin, this ridge at its basal portion being often reinforced by an extra development of the cingulum (see fig. 3), where the shallow ridge is designated by the letter *h*. The ridge usually divides the palatal aspect of the tooth into two unequal portions, the mesial being the larger. In the majority of teeth showing this ridge well developed the mesial and distal borders are usually raised, with the result that two shallow depressions are formed, as is shown in fig. 3.

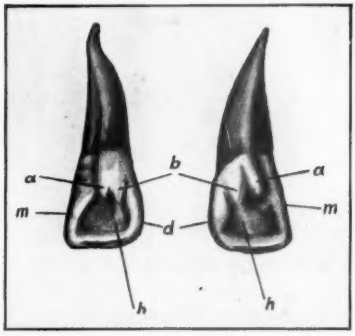

FIG. 3.

The palatal view of two maxillary incisors removed from the same individual. *a*, and *b*, cusps developed from basal ridge; *h*, ridge on palatal aspect; *d*, distal aspect; *m*, mesial aspect.

It is, I think, the strong development of the ridge *h* that gives rise to the type of tooth shown in fig. 4.

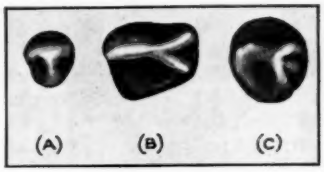

FIG. 4.

Supernumerary teeth showing the marked development of a ridge on the palatal aspect of the tooth.

At the junction of the ridge with the occlusal margin there is frequently an inward bend of the labial aspect (fig. 4 B). The ridge, too, usually runs in an oblique direction toward the occlusal margin, and so divides the palatal aspect into two unequal portions: (1) the mesial, slightly cup-shaped, and (2) the distal, which may form a deep cleft, as seen in fig. 4 B. From the basal ridge of this portion an additional cusp may arise, as shown in fig. 4 C.

Group V.—This type is shown in fig. 5. The occlusal surface has assumed a tuberculate appearance; it is still divided into portions by the ridge present in the preceding group, but further complication of pattern has been brought about by the elevation of the cingulum on the mesial and distal aspects, the elevation being more complete on the mesial than on the distal aspect.

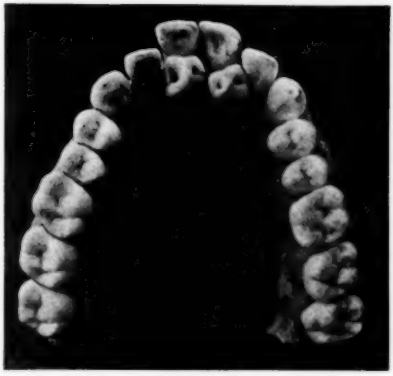

FIG. 5.

Supernumerary teeth of the tuberculate type.[1]

[1] I am indebted to Messrs. Longmans Green & Co., Ltd., for the use of this block.

Group VI.—In this group the occlusal surface is more or less triangular in shape, the three walls enclosing a depression of varying depth. The anterior surface is usually flat, the other two surfaces being convex. The examples shown in fig. 6 are of especial interest, inasmuch as the anterior aspect of the right-hand tooth shows a condition occasionally seen in the first incisor. The normal first incisor, when just erupted, usually shows three cusps on the occlusal margin, but four

cusps are not uncommon. In fig. 6 the right tooth shows four cusps at the cutting edge, which may be named *b*, *c*, *d*, *a*, counting from the mesial surface. The cusps *b*, *c*, *a*, are continued upwards as columns on the labial surface, and the cusp (*d*) is squeezed in between the columns *a* and *c*. In the fellow tooth the cusp (*d*) is not developed.

An examination of the occlusal surface of the teeth (fig. 6) shows that the posterior walls unite with the mesial and distal borders of the labial surface, and this would suggest that the teeth included in this group are due to a general elevation of the cingulum on the palatal aspect, with a lack of development of the ridge (*h*) to which attention has already been drawn.

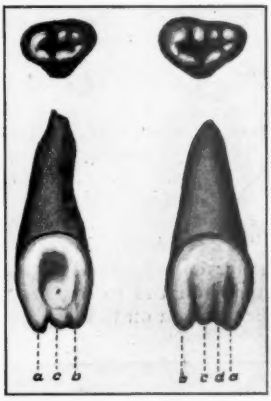

FIG. 6.

Two teeth removed from the premaxilla posterior to the position of the first incisors. The occlusal and labial aspects of the teeth are shown.

Group VII.—It is proposed to include in this group teeth showing a tendency to the development of cusps from the cingulum of the labial aspect. An example is shown in fig. 7.

FIG. 7.

A supernumerary tooth showing an elevation of the cingulum on the labial aspect.

Group VIII.—Here it is proposed to include supernumerary teeth in which it is difficult to trace a scheme of development. The tooth (fig. 8) would come into this group. The occlusal surface presents eight cusps—the one in the centre is conical-shaped and well-developed. It is possible that, with a larger number of specimens available for investigation, one may be able to arrange the teeth in this group under subheadings.

I pass now to consider the formation of tuberculate supernumerary teeth and also those abnormal teeth which at times are found in the position of the maxillary

incisors. We will first turn to the tooth shown in fig. 9 A. The crown resembles a second incisor, but the root is abnormal in shape. The cingulum is slightly elevated and there is a shallow fissure on the palatal aspect. A section through the tooth

FIG. 8.—A supernumerary tooth with eight cusps.

(fig. 9 B) shows a slight inflection of the enamel in the position of the fissure. This is an early stage of a condition which, as it increases, leads to more and more complexity in the shape of the tooth.

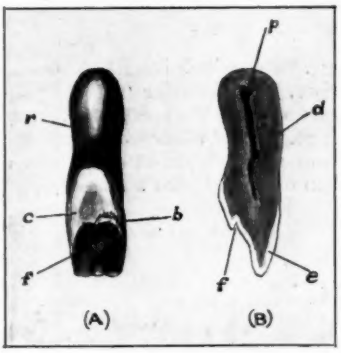

FIG. 9.

(A) Palatal view of a malformed second incisor: *c*, crown, *r*, root; *b*, enamel—fractured; *f*, fissure.

(B) Longitudinal section through (A). *d*, Dentine; *e*, enamel; *f*, inflection of enamel corresponding to position *f* (A); *p*, pulp cavity.

In the tooth (fig. 10 A) we have a further development of this intrusion of the enamel. The ridge (*h*) on the palatal aspect of the tooth is well developed, the cingulum is raised in the form of two cusps, *a* and *b*, and the mesial and distal borders are well developed, with the result that on either side of the ridge (*h*) there are depressions with clefts in the positions marked f_1 and f_2. A longitudinal section (fig. 10 B) taken through the line (1) shows a fairly deep invagination of the enamel (f_2) with the pulp-canal curving over the top of the cleft. A section through the position (2) also shows a less degree of dipping-in of the enamel.

The tooth shown in fig. 11 is a fairly common type of tuberculate-shaped tooth, the anterior and posterior aspects being separated by a deep fissure. A section through this class of tooth frequently reveals a very deep inflection of the enamel, as shown in the section, fig. 11 B.

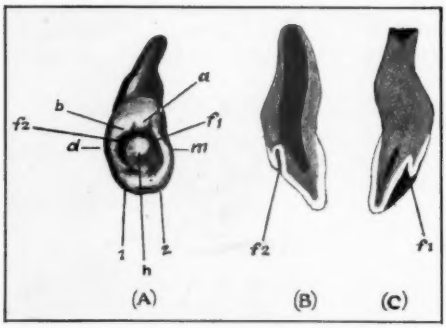

FIG. 10.

(A) Palatal view of a malformed second incisor: *a* and *b*, cusps developed from cingulum; f_1 and f_2, fissures on the palatal aspect of the crown; *d*, distal border; *m*, mesial border.
(B) Section through position 1 A. f_2, Inflection of enamel.
(C) Section through position 2 A. f_1, Inflection of enamel.

The tooth shown in fig. 12 A, which belongs to Group VI, erupted posterior to the position of the left incisor. The anterior surface is somewhat ovoid in shape, the mesial and distal margins are raised—the mesial more than the distal; the portion between the ridges is convex. The other walls, which for convenience we may describe as postero-external and postero-internal, are convex. The three walls enclose a cavity which, when examined with a magnifying glass, shows a deep fissure

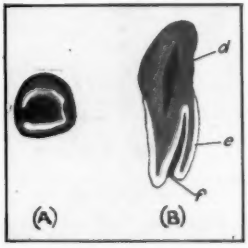

FIG. 11.

(A) Occlusal aspect of a tuberculate-shaped supernumerary tooth.
(B) Longitudinal section showing deep inflection of the enamel. *d*, Dentine; *e*, enamel; *f*, deep fissure.

extending down by the posterior walls (fig. 12 C). The postero-internal wall is marked by two grooves and the postero-external also by two grooves; there are therefore three cusps on the posterior aspect of the tooth. The tooth was divided into four sections: 1, 2, 3, 4 (fig. 12 C). In examining the appearances shown in the sections it must be remembered that a portion of the tooth was destroyed in making the cuts.

Section 1.—The mesial aspect of this section (fig. 12 B) shows a deep fissure situated to the posterior aspect of the pulp cavity.

Section 2.—The distal aspect (fig. 12 D) shows a wide depression separating the anterior and the posterior walls. The floor of the depression is indentated.

The mesial aspect is shown in fig. 12 E. The flat depression is present, but is narrowed, and there is a prolongation upwards of the enamel.

Section 3.—The distal aspect shows a narrowing of the flat depression and no tendency to an upward prolongation of the enamel.

In this specimen we have a depression separating the anterior from the posterior walls, and this depression in two places is prolonged upwards between the pulp cavity and the posterior wall.

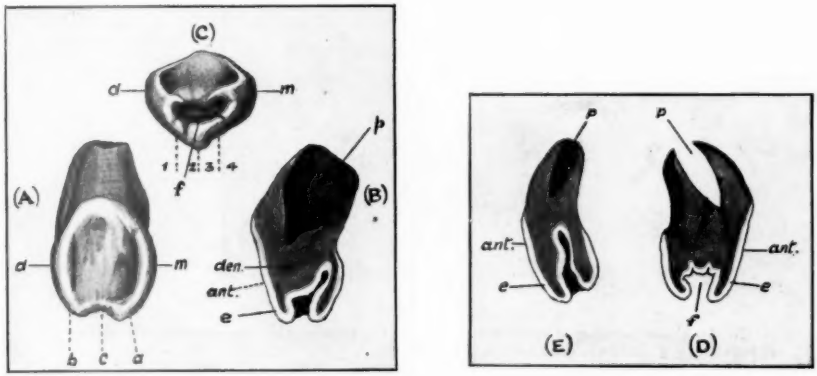

FIG. 12.

(A) Tooth removed from the left premaxilla. View of the anterior surface. *d*, distal aspect; *m*, mesial aspect; *a*, *b*, *c*, mark the position of three cusps.

(B) Section 1 (mesial aspect). *ant.*, Anterior aspect; *den.*, dentine; *e*, enamel; *p*, pulp cavity.

(C) View of the occlusal surface. *d*, Distal aspect; *m*, mesial aspect; *f*, deep fissure, 1, 2, 3, 4, indicate the four sections into which the tooth was divided.

(D) Section 2 (distal aspect). *ant.*, Anterior aspect; *e*, enamel; *f*, fissure; *p*, pulp cavity.

(E) Section 2 (mesial aspect). *ant.*, Anterior aspect; *e*, enamel; *p*, pulp cavity.

The specimen, fig. 13, is a stage towards complexity in the design of this variety of tooth. The columns *a* and *b* of the labial surface are curled forwards and give a crinkled appearance to the occlusal surface (fig. 13 B). A longitudinal section made in the position (*a*) (fig. 13 B) shows a deep infold of enamel (fig. 13 C). The other portion of the specimen was divided into sections, and showed that the deep infold extended to just beyond the line *b*, fig. 13 B. A microscopical examination made of this section showed that enamel only was present in the infold. The final section, taken at the position *c*, fig. 13 B, cut through a small islet of enamel situated to the anterior aspect of the tooth. The relations of this islet of enamel could not be determined.

A further stage of complexity in design is seen in fig. 14 B. On the labial or anterior aspect, the three ridges can be traced with an increased development of the central column near the cingulum so as to cause bulging of the wall in this position. Springing from the inner aspects of the columns (*b*) and (*c*), there is a ridge (*h*) which is everywhere separated from the postero-internal and postero-external walls by a deep fissure (*f*). The crown is bent slightly on the root and there is a little bulge on the mesial aspect of the tooth (fig. 14 A). A section of this tooth (fig. 14 C) was made in an oblique direction from the junction of the labial and postero-distal walls

to mid-way through the postero-mesial wall. An inflection of enamel posterior to the pulp cavity is indicated by (*f*) (fig. 14 C), the inflection diminishing in depth as the mesial angle is reached.

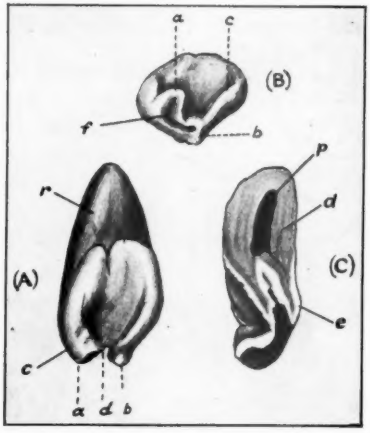

FIG. 13.

(A) An abnormal shaped tooth removed from the premaxilla. Anterior aspect. *c*, Crown; *r*, root; *a*, *b*, *d*, indicate the position of the cusps.

(B) View of the occlusal surface. *f*, Deep fissure.

(C) Section taken in a longitudinal direction through the position *a*, fig. 13 B. *d*, Dentine; *e*, enamel; *p*, pulp cavity.

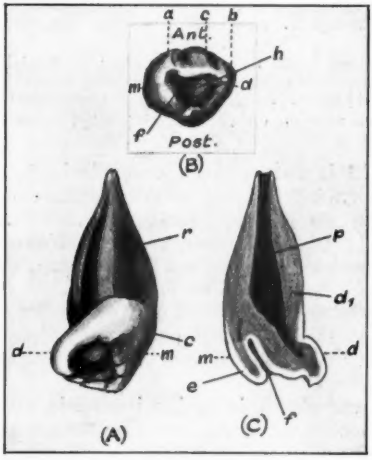

FIG. 14.

(A) Abnormal-shaped tooth from the premaxilla. *c*, Crown; *d*, distal aspect; *m*, mesial aspect; *r*, root.

(B) Occlusal view. *ant.*, Anterior aspect; *post.*, posterior aspect; *d*, distal aspect; *m*, mesial aspect; *h*, ridge; *a*, *b*, *c*, ridges on the anterior aspect; *f*, deep fissure.

(C) Longitudinal section. *d*, Distal aspect; *m*, mesial aspect; *p*, pulp cavity; d_1, dentine; *e*, enamel; *f*, fissure.

The specimen, fig. 15 A, is an example of the teeth included in Group V. A diagrammatic view of the occlusal surface is shown in fig. 15 C. A fissure (*f*) is present on the distal aspect; on the mesial aspect there is a shallow depression bounded by the walls (*a*) and (*d*). A longitudinal section made in the mesio-direction is shown in fig. 15 B. The fissure (*f*), it will be noted, extends upwards and inwards and is separated from the depression (*i*) on the mesial side by the ridge (*h*). The cavity would appear to be due to an elevation of the posterior cingulum (*c*) but with an absence of fusion with the wall at (*b*). On the mesial side there is an intrusion of enamel into the root, but the cingulum has risen very little, although the mesial border (*a*) of the tooth has thickened sufficiently to give rise to a shallow depression lined with an irregular deposit of enamel.

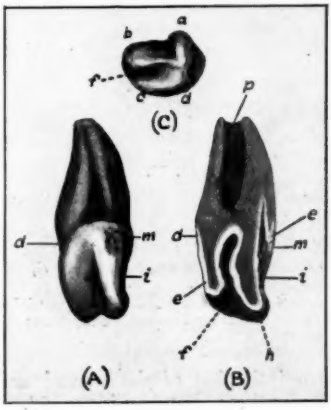

FIG. 15.

(A) Malformed tooth removed from the region of the premaxilla. *d*, Distal aspect; *m*, mesial aspect; *i*, depression lined with an irregular deposit of enamel.

(B) Longitudinal section (diagrammatic). *e*, Enamel; *p*, pulp cavity; *f*, fissure leading from the exterior of the tooth to an enamel-lined cavity; *m*, mesial aspect; *d*, distal aspect; *i*, depression lined with an irregular deposit of enamel; *h*, ridge.

(C) Diagrammatic view of the occlusal surface.

A further stage in the development of this type of tooth is shown in fig. 16. A semi-diagrammatic view of the occlusal aspect (fig. 16 A) shows that there is a ridge (*h*) stretching between the labial and palatal aspects; on the mesial side of the ridge there is a circular pit (f_2), and on the distal side a wider and longer depression (f_1). The tooth was divided in a mesio-distal direction, in the position of the dotted line. The anterior section (fig. 16 B) shows a deep inflection of the enamel running anterior to the pulp canal; the posterior section (fig. 16 C) shows a depression which, at its distal end, is continued upwards towards the posterior aspect of the tooth. If we examine the latter depression a little more carefully, we find that its posterior wall is formed by the cusps, 1 and 2, and that the upward prolongation of the enamel is brought about by a considerable development of the distal border of the palatal aspect and a folding of the border toward the cusp 2, the meeting-place being marked by a groove (*g*, fig. 16 A). In this tooth we have two definite inflections of the enamel separated the one from the other by the ridge (*h*).

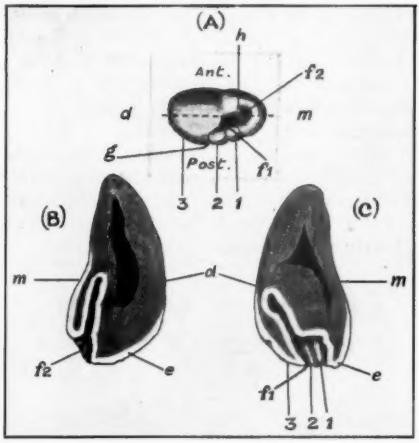

FIG. 16.

(A) View of the occlusal aspect of a malformed tooth from the region of the premaxilla. *ant.*, Anterior surface; *post.*, posterior surface; *d*, distal surface; *m*, mesial surface; *h*, ridge connecting anterior and posterior surfaces; 1 and 2, cusps developed from the basal cingulum: 3, distal border overlapping cusp 2, leaving a fissure, *g*; f_1 and f_2 depressions.

(B) Mesio-distal section, anterior portion of the tooth. *d*, Distal surface; *m*, mesial surface; *e*, enamel; f_2, inflection of enamel.

(C) Mesio-distal section, posterior portion of the tooth; *m*, mesial surface; *d*, distal surface; *e*, enamel. 1 and 2, Cusps developed from the basal cingulum; 3, distal border; f_1, fissure leading to deep inflection of enamel.

With the deepening of the inflection of the enamel and the contraction of the walls of the tooth, we arrive at the stage shown in fig. 17.

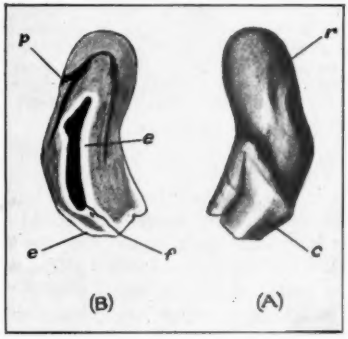

FIG. 17.

(A) Abnormal-shaped tooth removed from the premaxilla. *c*, Crown; *r*, root.

(B) Longitudinal section. *e*, Enamel; *p*, pulp cavity; *f*, fissure leading to cavity lined with enamel.

This tooth is typical of a well-marked group of abnormal shaped teeth. The crown resembles a blunt cone, the root is roughly cylindrical until just before the end where it is rounded. A careful examination of the crown will invariably disclose

a small opening through the enamel. This type of tooth was originally described by Sir John Tomes in the first edition of his "Dental Surgery." Fig. 17 B is a diagrammatic view of a section taken through the centre of the tooth. The cavity in the centre of the tooth is lined with a thick layer of enamel, and an opening exists between the exterior of the tooth and the enamel-lined cavity.

Another example is shown in fig. 18. Here the crown is cone-shaped and there is an elevation of the enamel at the cervix (*g*). The section has been made a little to one side of the depression on the crown and gives the appearance that the enamel-lined cavity is completely cut off from union with the external enamel. The pit (*f*), fig. 18 B, leads to the depression on the outer side of the tooth. The deposit of enamel lining the cavity is thicker and more regular in the crown than in the root portion.

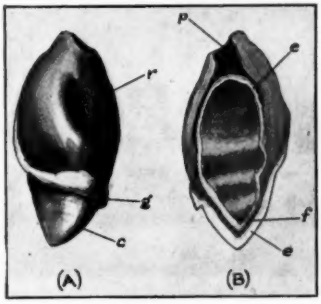

FIG. 18.

Abnormal-shaped tooth from the premaxilla.

(A) General view. *c*, Crown; *r*, root; *g*, elevation of the enamel at the cervix.

(B) Longitudinal section. *e*, Enamel; *p*, pulp cavity; *f*, pit leading to canal opening on the surface of the tooth.

The next specimen, fig. 19, is similar to that shown in fig. 18, and it is interesting as showing a smaller degree of intrusion of the enamel. The section has been taken through the side of the cavity.

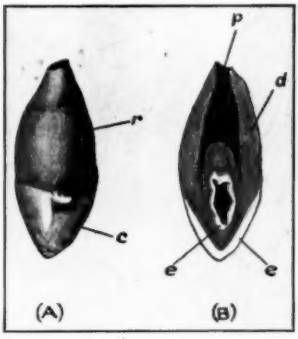

FIG. 19.

(A) General view of the tooth. *c*, Crown; *r*, root.

(B) Longitudinal section (diagrammatic) *d*, Dentine; *e*, enamel; *p*, pulp cavity.

A microscopical section, fig. 20, prepared from part of the specimen cut through the channel leading from the enamel-lined cavity to the exterior of the tooth. The section shows that the enamel lining the intrusion is irregularly deposited, is coarse in texture, and is surrounded by dentine except at one part where there is an area of tissue which has the appearance of a vascular cement.

FIG. 20.
Microscopical section of the tooth shown in fig. 19.

One of the best examples I have seen of this type of tooth was presented to the Museum by A. L. Whitehouse. The crown portion (fig. 21) has a labial surface similar to that of a normal second incisor. The occlusal margin has been worn to the dentine by attrition. The root expands gradually for about two-thirds of its length and then contracts abruptly to enclose a large opening to the pulp cavity.

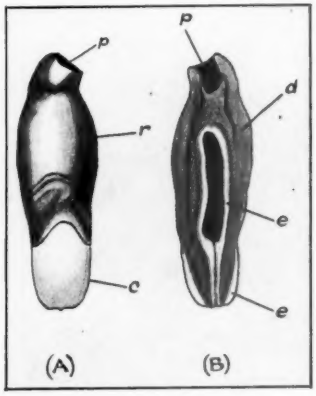

FIG. 21.
(A) Malformed tooth from region of the maxillary second incisor. *c*, Crown; *r*, root; *p*, opening leading to pulp cavity.
(B) Longitudinal section (diagrammatic) of A. *d*, Dentine; *e*, enamel; *p*, pulp cavity.

The cavity inside the tooth, fig. 21 B, is elongated, being 10 to 11 mm. long, and is connected with the external surface by a narrow tube, 5 mm. in length. A feature of this specimen is the well-developed layer of enamel forming the wall of the intrusion.

In one specimen, fig. 22, there are two definite intrusions each communicating with the exterior of the tooth. Unfortunately, only half the tooth is in the collection, so one cannot obtain a reliable idea of the shape of the whole tooth. The section, fig. 22 C, was made in a mesial-distal direction and shows two very definite intrusions.

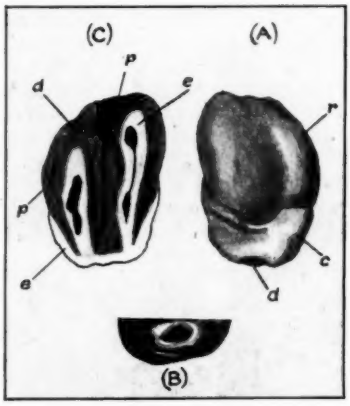

FIG. 22.

(A) General view of a malformed tooth from the region of the premaxilla. *c*. Crown; *r*, root; *d*, depression on the occlusal surface of the tooth.
(B) View of the occlusal surface.
(C) Longitudinal section (diagrammatic) of A. *d*, Dentine; *e*, enamel; *p*, pulp cavity.

So far I have dealt with a series of specimens which seem to be developed on similar lines. I now pass to groups, the relationship of which the one to the other is not quite clear but which one feels with further knowledge will work into one connected sequence.

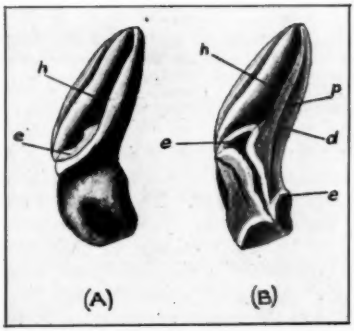

FIG. 23.

(A) Abnormal tooth removed from the region of the maxillary left second incisor. *e*, Circular mass of enamel; *h*, root of the tooth in the form of a "hood."
(B) Section taken in the mesio-distal direction (diagrammatic). *d*, Dentine; *e*, enamel; *h*, root; *p*, pulp canal.

There is a type of tooth with the root distorted into the form of a hood over a circular piece of enamel. The features of this type are exhibited in the specimen shown in fig. 23.

The tooth was removed from the region of the maxillary second incisor and the crown is similar in shape to that tooth, with the exception of a ridge running down the middle of the lingual aspect. The root portion is bent towards the mid-line of the mouth; the superior surface is of an oval-saucer-shape with the margins bent inwards in places. At the junction of the root with the crown there is a piece of enamel, circular in shape, which is penetrated in the centre by a canal leading to the centre of the crown. A section through the specimen (see diagram fig. 23 B) shows that the circular patch of enamel seen in the root extends through the crown and blends with the external enamel. There is a canal through this tongue of enamel and a very small opening on the outer side of the tooth.

There is also an excellent example similar to the above specimen given to the collection by J. W. Pare, and one showing an early stage of the deformity presented by A. Hubert Butcher. J. E. Freeston[1] gives four illustrations of a similar type of tooth, and in Wedl's Atlas[2] there is a drawing of one removed from the position of the maxillary left second incisor.

In this group should be included the specimen described in the *Transactions of the Odontological Society*, Vol. IV, Old Series, 1863-64-65, p. 37, and shown in fig. 24. The

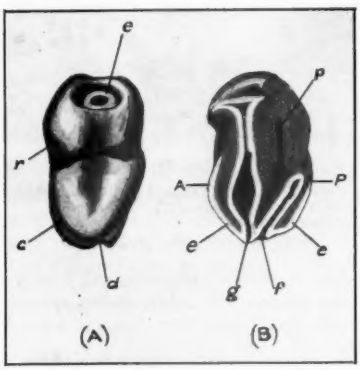

FIG. 24.

(A) Malformed tooth removed from the position of the maxillary right first incisor. *c*, Crown; *d*, pit in the occlusal surface of the tooth; *e*, circular mass of enamel; *r*, root.
(B) Longitudinal section (diagrammatic) of A. *a*, Anterior aspect; *p*, posterior aspect; *e*, enamel; *p*, pulp canal; *f*, inflection of enamel extending upwards posterior to the pulp canal; *g*, canal leading to an enamel-lined cavity which opens on the surface of the root.

crown does not simulate a normal incisor but is of the blunt-coned tubercular type. The upper surface of the tooth shows a ring of enamel with an elevation of the cement all round except on the anterior aspect. The occlusal surface shows a triangular opening characteristic of the tubercular type of supernumerary tooth. The tooth, removed from an individual 28 years of age, had displaced the right first incisor forwards. There was a history of a similar shaped tooth having erupted in the position of the left incisor. A section taken through the middle of the tooth in an antero-posterior direction gives the appearance shown in fig. 24 B. There is (1) an

[1] *Dental Cosmos*, March, 1893.
[2] Edit. 1893, fig. 31, plate 11.

inflection of enamel (*f*) running in an upward and backward direction posterior to the pulp cavity; (2) an enamel-lined cavity opening upon the upper surface of the root and communicating at (*g*) with the exterior of the tooth.

A type of tooth which is clearly related to the foregoing group is illustrated in fig. 25. This abnormality occupied the position of the second incisor. The crown of the tooth is triangular in shape, one side being convex from side to side, the other two sides being concave. The root first expands outwards from below upwards and then curls inwards to encircle a wide opening which leads to a "crater-like" cavity.

In the margins of the cavity walls there are shallow slit-like depressions which mark the entrance to the pulp cavity. The length of the tooth is 14·5 mm. and the greatest width 14·5 mm.

A section (fig. 25 B), shows that the cavity extends throughout the length of the tooth, the walls of the crown portion being scarcely 2 mm. The cavity is lined everywhere with an irregular deposit of enamel, the deposit being thicker towards the upper part of the cavity. There is no cement covering the deposit of enamel. In the crown portion the outer and inner layers of enamel are separated by a layer of dentine, the dentine in the root portion being covered with cement. The pulp cavity

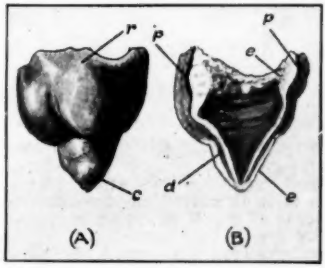

FIG. 25.

Abnormal-shaped tooth removed from the region of the second incisor.
(A) General view. *c*, Crown; *r*, radicular portion.
(B) Longitudinal section (diagrammatic). *d*, Dentine; *e*, enamel; *p*, pulp cavity.

which opens at the free margin of the tooth can be traced downwards towards the crown.

A specimen similar in character to the foregoing was described by Graves-Morris and Woods.[1] In this tooth the cavity was lined in parts by cement with here and there patches of enamel. Where the enamel was present the cement was absent.

The tooth (fig. 26) is, I am inclined to think, a stage in the development of these "hooded teeth." The value of the specimen has been marred by the presence of caries. The anterior aspect (fig. 26 A) of the tooth is shaped like a first incisor with the reservation that it is indented in a manner similar to some specimens belonging to Group IV of supernumerary teeth. About one-third up the root there is a bulge and on the distal aspect there is a deep pit. The cingulum is raised at (*c*), fig. 26 B, and ends in a projection covered with hypoplastic enamel which terminates in a pit that shows caries. The tooth divided in a mesio-distal direction (fig. 25 C), cut through a cavity lined with enamel which was shown in the opposite section to fuse with the enamel at the part (*f*). The pit (fig. 26 D) is continued towards the cusp, and is lined with an irregular deposit of what appears to be enamel that unites with the outer enamel of the cusp, which unfortunately is carious.

[1] *Brit. Dent. Journ.*, Sept. 1, 1913, p. 63.

With a certain amount of hesitancy I am including in this group the specimen (fig. 27) removed from the position of the left second incisor. The occlusal surface presents two depressions separated by a wide ridge; this feature would seem to bring the tooth into Group VI. There is a fissure in the position (*f*); unfortunately the tooth in this part has been attacked by caries. It is difficult to determine exactly the relations of the tooth, but, examining it by the light of other specimens, I think the surfaces can be placed as shown in the figure. An idea of the shape of the tooth

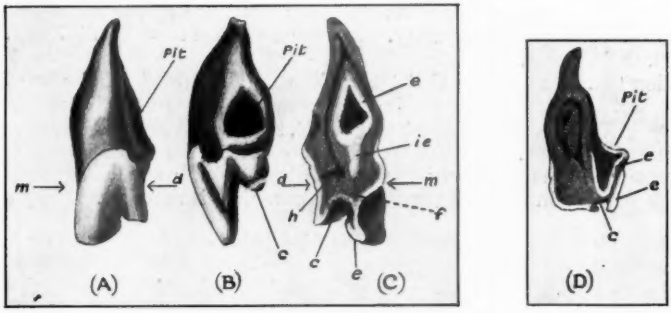

FIG. 26.

Abnormal-shaped tooth from the premaxilla.

(A) View from the anterior aspect. *d*, Distal aspect; *m*, mesial aspect; *pit*, opening to deep pit.

(B) View of the distal aspect. *c*, Cusp showing caries.

(C) Longitudinal section taken in mesio-distal direction. *m*, Mesial aspect; *d*, distal aspect; *e*, enamel; i.e., tongue of enamel extending in opposite section to *f*; *c*, caries; *h*, prolongation of pulp cavity towards distal aspect.

(D) Longitudinal section through the "pit" (figs. A and B). *e*, enamel; *c*, caries.

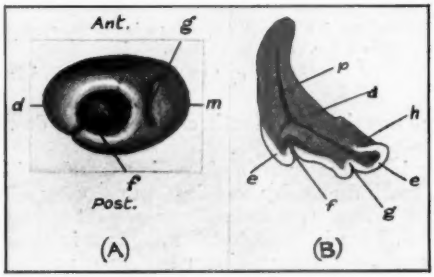

FIG. 27.

(A) Malformed tooth removed from the region of the maxillary left second incisor. *ant*, anterior aspect; *post*, posterior aspect; *m*, mesial aspect *d*, distal aspect; *f*, fissure; *g*, shallow groove.

(B) Section (diagrammatic) in a mesio-distal direction. *d*, Dentine; *e*, enamel, *f*, fissure; *g*, shallow groove; *h*, cement; *p*, pulp cavity.

can be obtained from the diagram (fig. 27 B). The root, slender and tapering, lie. under the distal part of the crown, the mesial portion of which is prolonged outwards From the diagram it will be seen that the enamel, after turning upwards from the occlusal surface, bends abruptly to run parallel with the occlusal surface, and in this

part of its course it is overlapped by a thick layer of cement (*h*). The position of the groove (*g*) on the occlusal surface is shown by a slight indentation of the enamel.

The last group of specimens to be described seems to bridge the gap between the hooded, rooted tooth, with its incomplete intrusion of enamel, and the tooth where the intrusion is complete. The abnormal shaped tooth shown in fig. 28 was removed from the mouth of a lad aged about sixteen years. It occupied the

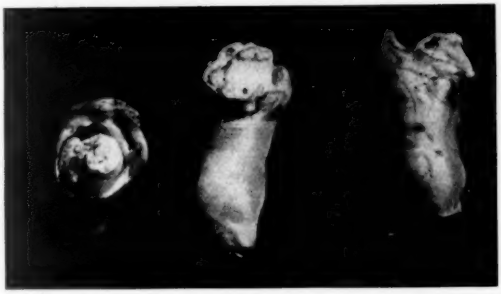

FIG. 28.

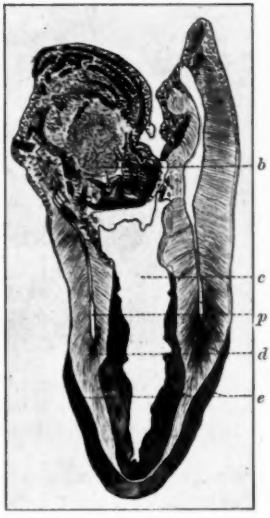

FIG. 29.

Diagrammatic view of a longitudinal section through the tooth shown in fig. 28.
b, cement-like tissue ; *c*, cavity in centre of the tooth ; *p*, pulp-cavity ; *d*, dentine ; *e*, enamel.

position of the maxillary left second incisor. A sinus was present on the outer aspect of the alveolar process, and this led to a well-marked cyst-like cavity in the bone. The boy had suffered from rickets during childhood. The tooth is cone-shaped, the base of the bone embracing a curious nodular mass, which is fused with the base of the cone at the posterior or palatal aspect. A section through the

tooth is shown in fig. 29. The outer coat consists of enamel and cement; internal to this is dentine. There is a large cavity in the centre of the tooth, the lower half of which is lined with a layer of enamel. The dentine forming the posterior or palatal wall of the tooth is at its upper part continuous by means of a very vascular tissue, with a circular mass of tissue embraced by the base of the cone. This globular mass shows in section a well-marked concentric lamination, and is composed of vascular cement tissue.

S. J. Hutchinson [1] described a specimen which was very similar in its features to the one that came under my notice. The patient was 13 to 14 years of age, the tooth occupied the position of a second incisor, and there was a history of suppuration. A drawing of a longitudinal section of this tooth is shown in fig. 30. In this instance the cavity in the tooth was completed in part by a mass of cemental tissue, and the development of the abnormality seems to have advanced a stage further than in my specimen.

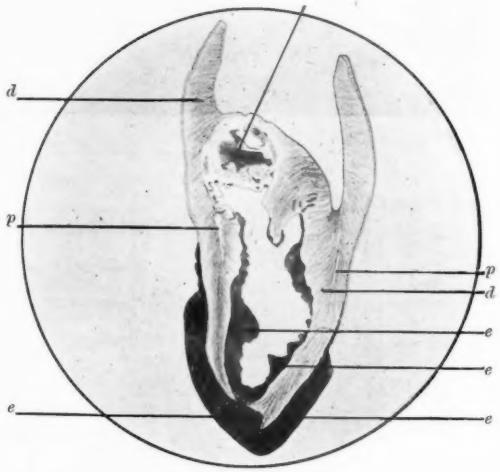

FIG. 30.
Abnormal shaped tooth removed from the region of the left premaxilla.
d, dentine; *e*, enamel; *p*, pulp cavity.

Under the title "Dilated Composite Odontome," J. A. Woods described [2] a specimen with features somewhat similar to those noted above. The tooth occupied the position of the maxillary left canine—the presence or absence of the second incisor is not mentioned.

The teeth described in this paper afford sufficient evidence to support the view expressed at the beginning of this paper that these abnormal teeth develop according to a law, or laws.

Mr. J. LEWIN PAYNE (President) said that Sir Frank Colyer, in a paper of very great value had demonstrated the difficulties met with in attempting to classify abnormal teeth. He (Sir Frank) had made careful and accurate observations upon specimens shown that might have been described as invaginated, dilated, gestant, or germinated teeth, as well as a number of other types. Should all of these teeth be considered as simple supernumeraries or abnormalities, or were we justified in calling some of them odontomes? The question had often been asked as to the line of demarcation which divided the two groups. Were we to call them

[1] *Trans. Odont. Soc.*, xi, n.s., p. 163.
[2] *Dental Record*, xxxv, p. 389.

developmental anomalies, or were we to call them odontomes? He (the speaker) would rather ask: Was there any exact line of demarcation? When examining a large number of such specimens one was impressed by the frequency with which supernumerary teeth showed something more than numerical abnormality and small differences in external appearance. In a large proportion of the specimens, when sections were cut, the tissues were found to be arranged altogether differently from those of normal teeth. Probably we were all agreed that until the ætiology of malformations and neoplasms was understood no classification could be entirely satisfactory. But, by considering such abnormal teeth and odontomes in association one with the other, he (Mr. Payne) believed we should arrive at the truth more speedily. The classification in "The Report on Odontomes" had been criticized for being so daring as to introduce into the category of odontomes such ordinary things as enamel nodules. The principle adopted in that classification had been founded upon aberrant growth of the cells concerned in tooth development, and whilst, doubtless, to-day some revision was desirable, the arrangement suggested in 1913 was a distinct advance upon previous classifications. For his own part he (the speaker) thought that if criticism was to be offered, in the light of recent knowledge, it should be that the authors of that "Report" were too timid. He (Mr. Payne) would be more daring and revolutionary and would urge, until the discovery of the ætiology of malformations and neoplasms was made, that all abnormalities such as supernumerary, germinated teeth, and others, should be grouped with what had been known as true neoplasms and described under one classification. If a study of the simpler abnormalities could be carried out during earlier stages of their development and a comparison made with true odontomes, more knowledge of their pathology would be gained and we should have a better prospect of discovering their ætiology. Albrecht had long taught that all tumours were malformations, and that many could not be separated from hyperplasia and other abnormalities of growth. Moreover, it was not always possible to distinguish new growth from development. Congenital tissue malformations merged imperceptibly into certain types of neoplasm. He (the speaker) suggested that these abnormal teeth should be considered as neoplasms and be grouped together. This would mean a change of terms and probably a modification in some of our definitions; but by studying such malformations in this light we should be able to make valuable contributions to the pathology of odontomes and possibly also to the morbid and histological aspect of tumours in general, and in time advance towards the discovery of their ætiology, upon which so much depended.

Section of Odontology.

President—Mr. J. Lewin Payne, O.B.E., L.R.C.P.Lond., M.R.C.S., L.D.S.Eng.

Circulation of Lymph in the Dentinal Tubules with some Observations on the Metabolism of the Dentine.

By E. W. Fish, M.D., Ch.B., L.D.S.

(From the Department of Bio-Chemistry and Physiology, University College, London.)

PART I.

The Flow of Lymph along the Tubules and its Return to the Pulp.

In a preliminary report read before this Section last year,[1] it was described how substances injected either intravenously or subcutaneously into the body had been recognized subsequently in the dentine. Trypan blue, detected by its colour, and iron solution for which special tests were used, were found in the middle of the dentine within an hour or less of their injection into the blood-stream. When the dye was given in repeated weekly doses so that the tissues were kept saturated, the

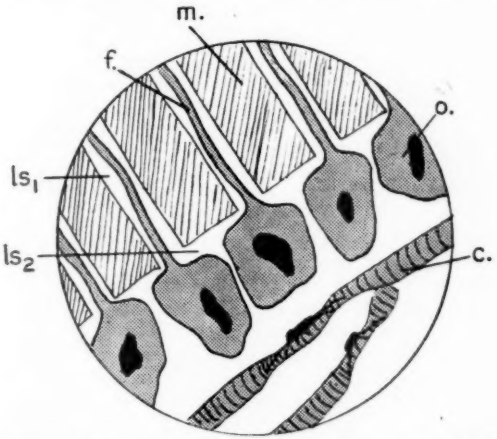

Fig. 1.—Schematic diagram to illustrate the observations that have been made on the circulation of lymph in the dentine. *o*, odontoblast; *f*, fibril; *m*, matrix substance of dentine; ls_1, lymph space in tubule; ls_2, subdentinal lymph space; *c*, capillary with Rouget cell.

dentine was quite deeply stained; but it could not be determined whether the colouring matter was carried into the dentine by an active circulation of body fluids along the tubules, or merely by diffusion along the cytoplasm of the dentinal fibril.

If it be assumed for the moment that an active circulation of lymph occurs, then one would expect to find, as in fig. 1, a lymph space between the odontoblast layer

[1] E. W. Fish, "Circulation of Lymph in the Dentine," *Proc. Roy. Soc. Med.*, 1925, vol. xviii (Sect. Odont.), pp. 35-37.

and the dentine, around the roots of the dentinal fibrils; and that this space would be continued up around each fibril in its tubule. If this supposition be correct, it should be possible to introduce a substance into the dental pulp, whence it would be carried into what we may call the subdentinal lymph space between the odontoblasts and the dentine, and from there into the tubules by the lymph stream.

In order to prove, however, that the foreign substance introduced is actually carried into the tubules by lymph circulation and not by simple diffusion, it is essential to use a non-diffusible substance such as indian ink, which consists of particles of insoluble pigment suspended in a fluid medium. This is necessary, because if the experiment be performed, as it has been, with methylene blue, neutral red, or similar soluble dye, the dye rapidly appears in the tubules; but it is difficult to say whether it is in the fibrils or outside them in the supposed lymph space. On the other hand, when indian ink is used, the finely divided particles of pigment cannot penetrate the cell membrane of the odontoblasts, and would not diffuse along the fibril even if they did penetrate the cells. When, therefore, these granules appear in the tubule, they must be lying in a space outside the fibril, and must have been carried there by a movement in the fluid contents of that space.

The following experiment was accordingly devised. A young dog of a large breed was selected in order to give as great a ratio as possible between the size of the pulp and that of the hypodermic needle used to introduce the ink, thereby minimizing the disturbance of the pulp elements by the needle. The animal was anæsthetized with chloroform and ether-chloralose sequence, and part of the crown of one of the

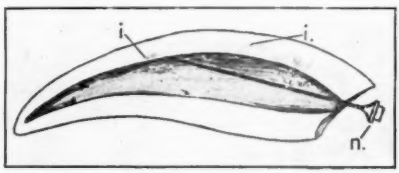

FIG. 2.—Drawing of canine of dog cut longitudinally. *i*, indian ink in substance of dentine; *n*, needle *in situ*. When the experiment is being made the ink is allowed to leak out as the needle is being withdrawn.

canine teeth was sawn off to expose the pulp. A syringe was filled with indian ink and fitted with the finest ordinary hypodermic needle. The needle was introduced along the wall of the pulp chamber to about half-way down the root, and while it was being slowly withdrawn ink was allowed to leak out of it. It has been found important to use no pressure whatever, since if one does the pulp is torn from the dentine and circulation in that tissue immediately ceases. Various inks have been used, and ink diluted with saline, but the most constant results are obtained with Reeves' waterproof ink. After the injection it is not necessary to seal the pulp chamber, but the dog should be left for an hour or so before being killed. The tooth may then be cut in half, when the ink will be found to have penetrated into the dentine, as shown in fig. 2. Fig. 2 also shows the position of the needle before being withdrawn.

When one examines sections of such a tooth microscopically, it is seen that where the most massive deposit of ink occurs very little of it is carried into the dentine, since the normal circulation has been interfered with too seriously at this point. A little further along, however, where the odontoblasts are undisturbed, but where ink has infiltrated between the odontoblasts and the dentine, the particles of ink have also been carried into and along the tubules. In fig. 3 a collection of ink is seen in the subdentinal lymph space, and the granules have entered a number of tubules,

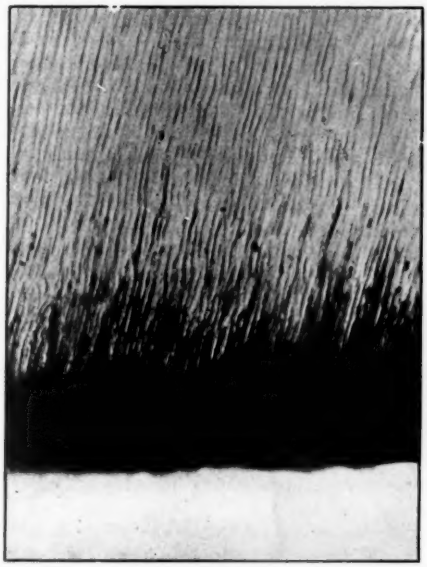

FIG. 3.—Photomicrograph. Indian ink in the subdentinal lymph space. The deposit of ink is so massive that while it has entered many of the tubules it has not penetrated very far. (1/6 in. objective.)

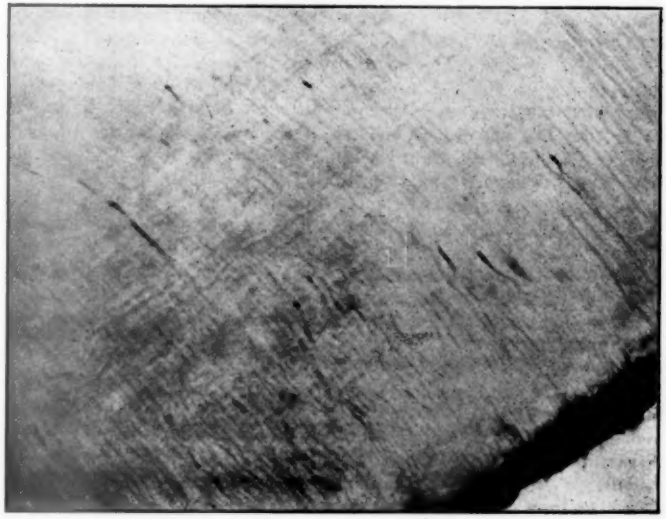

FIG. 4.—Photomicrograph. The indian ink has been carried further along the tubules in this section and can be seen in the middle third of the dentine. The ink was introduced into the pulp one hour before the animal was killed. (1/6 in. objective.)

but have not penetrated very far along them. The larger granules of ink have apparently blocked the way, and the lymph flow has ceased. This is due to the fact that the photograph displays a part of the dentine near the site where the ink was introduced. In other parts of the dentine, where there is less disturbance of the pulp elements, the ink is seen, as in fig. 4, to have been carried very much further along the tubules. In view of these findings, it became evident that there must be a lymph stream along the tubules in the space around the fibrils, and fortunately it was possible to demonstrate this perfectly clearly in transverse sections of the ink-bearing tubules where the particles of ink are invariably confined to the periphery of each tubule. Sometimes a large granule will displace the fibril to one side, and a crescent of ink presents. In other cases the granules are smaller and are disposed peripherally, showing as circles surrounding a clear centre, which is the fibril (fig. 5).

The next point was to observe the depth to which the ink was carried into the dentine, and to do this a large number of teeth had to be examined after ink had been introduced into their pulp chambers. It was possible to trace the ink two-thirds of the way across the dentine from the pulp, a distance which had been traversed in the course of an hour. This has been repeatedly observed, but it has not been possible to find it carried through to the cement or enamel junction, although a modification of technique, now to be described, was used in an attempt to demonstrate complete penetration of the dentine with ink. The modification consisted in leaving the ink in the pulp for twenty-four hours, and at the same time producing hyperæmia of the pulp with a trace of arsenic. A large young dog was put under chloroform and ether, part of the canine crown was sawn off, and ink infused as before. A fragment of arsenic fibre was then placed in the orifice of the pulp chamber, and the cavity was sealed up with cement. The dog was allowed to recover consciousness, and twenty-four hours later was killed.

In sections of such teeth (fig. 6) the ink is found to have penetrated two-thirds of the way across the dentine from the pulp to the surface, in several places. The granules also appear finer, or rather the coarser ones have not travelled down the pulp to that part of the dentine where this deep penetration is observed. The most interesting feature of these sections, however, is the amount of blood-pigment that appears in the tubules. The hæmorrhage which results from the operation, and perhaps from congestion due to the arsenic, is followed by hæmolysis, and the lymph is now tinged with hæmoglobin. It can, therefore, be traced to the most peripheral part of the dentine, but the colour becomes fainter and fainter as we pass outwards from the pulp. At first ink granules appear here and there in a red fluid in the tubules, then the ink ceases and the fluid is only faintly pink; then, just as we approach the cement or enamel, it is impossible to be sure that there is any pink colour left at all. If such a section be now stained with potassium ferrocyanide the hæmoglobin turns blue by virtue of its iron content, and can be seen in places to extend right up to the dentine-cement junction, where a marked accumulation is observed as a blue line just at the margin of the dentine.

This observation suggested a different method of investigation, as it seemed unlikely that anything further was to be learnt from the use of indian ink. The ink method had, however, served a useful purpose in that these experiments offer a marked contrast to those of other investigators who worked upon extracted teeth, introducing indian ink into the pulp chamber after removing the pulp, and subjecting the ink to a pressure of from five to ten atmospheres for twenty-four hours. By this means ink granules were forced into the tubules, but the experiments just described show that there exists a stream of lymph along the tubules during life of such a character and volume that ink granules are carried by it into remote parts of the dentine within so short a space of time as one hour. The tubules may, therefore, be looked upon as lymph channels, and by means of the circulation of the lymph in them, nutrient materials, oxygen and immune bodies, are transported to the living

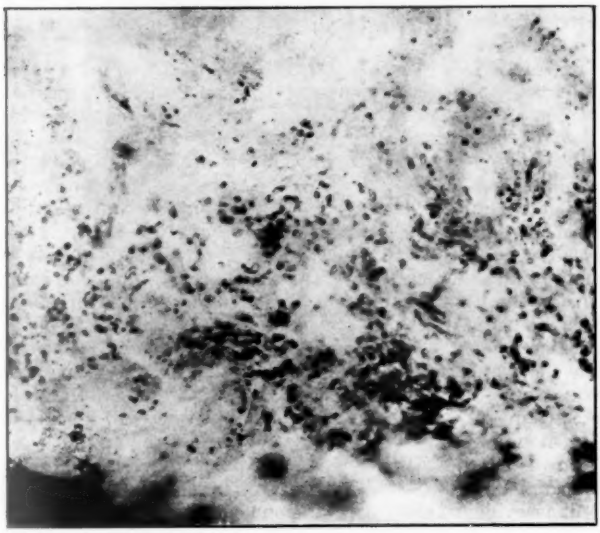

FIG. 5.—Photomicrograph. Transverse section of tubules containing indian ink. The granules are seen placed peripherally round the fibril in the tubule. The fibril appears as a clear centre surrounded by a ring of ink. In some tubules the fibril is displaced eccentrically and the ink shows as a crescent. (1/6 in. objective.)

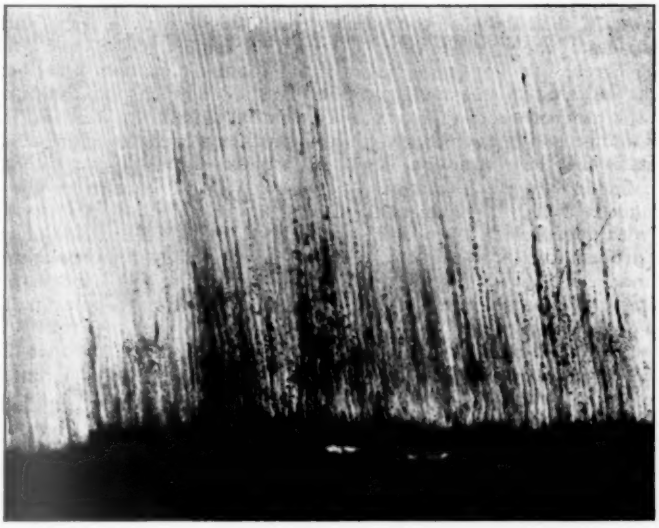

FIG. 6.—Photomicrograph. Section of dentine from canine of dog. Indian ink and As_2O_3 placed in pulp twenty-four hours before animal was killed. The hæmoglobin-stained lymph shows grey with black granules of ink at intervals along the tubules. (1/6 in. objective.)

dentine, and the products of its katabolism are carried away. It appears that the fibrils of the odontoblasts which lie in these lymph channels exert a controlling influence upon the metabolic processes in the dentine.

It was therefore decided, at this point, to discard indian ink as an indicator, and to attempt to trace further the course of the circulation by means of a reagent which did not contain suspended particles, and which, therefore, would not interrupt the lymph flow by blocking the tubules. For this purpose a solution of ferrous ammonium citrate 0·5 per cent. was introduced into the pulp and the animal was killed an hour later. The tooth was placed in formalin solution to fix the dentine and then decalcified. The iron solution became mixed with the lymph in the pulp and was carried along the tubules as the lymph circulated, during the time which elapsed between its introduction and the animal being killed. It was, therefore, only necessary to immerse a section of the tooth in potassium ferrocyanide solution, thereby producing the Prussian-blue reaction to render the lymph visible as a dark, blue fluid throughout the whole of its course.

It now became evident that the lymph penetrates all the tubules of the dentine right up to the cement margin, and where a tubule is cut in transverse section the lymph shows as a blue ring surrounding the fibril precisely as the ink had done.

The most striking feature of these sections, and one that appears in all of them, is a marked accumulation of lymph in a zone just at the periphery of the dentine, both in the crown and in the root. This shows, under a low power, as a narrow blue band immediately under the granular layer of Tomes (fig. 7). Under a higher power (fig. 8) it is evident that this blue zone corresponds to the area in which the terminal branches of the tubules occur. These branches can be seen very clearly, charged with lymph, while between them and the cement in most places is the granular layer of Tomes free from lymph. The branches form a plexus into which the tubules pour their contents, thereby producing the blue zone which is such a striking and constant feature of these sections. From this plexus the greater part of the lymph returns to the pulp along neighbouring tubules. There can be no doubt, however, that some of the tubules reach the cement margin, and it may be that the spaces of the granular layer of Tomes are lymph spaces.

In the coronal part of the tooth, dentinal tubules have been described by many workers as entering the enamel, and the present writer has, in the last few days observed the penetration of lymph into the cervical part of the enamel; but it is not proposed to discuss the movements of the lymph outside the confines of the dentine at present, as they have not been completely worked out.

The ultimate fate of the lymph which returns to the pulp from the tubules is clearly indicated in fig. 9. Here are seen numerous small lymphatic vessels heavily charged with indian ink which had been introduced into the tissue of the pulp an hour before the animal was killed. These vessels are seen to enter channels through the dentine in its apical portion, and in this way to make their escape from the pulp chamber. There also appear to be perivascular lymph spaces around the blood-vessels, where they lie in the apical canals of the dentine.

It now remains to discuss the mechanism by which this movement of lymph in the tubules is maintained, and it will be seen at once that this circulation differs materially from lymph movement in some other tissues in that it is so isolated that the action of the neighbouring muscles can exert no influence over it. The lymph must, therefore, gain its motive power entirely from the blood-pressure. A. W. Wellings[1] has described the occurrence of contractile Rouget cells on the capillary walls, in the network of vessels which appears at the surface of the pulp, immediately below the odontoblast layer. These cells, by alternately contracting and expanding the calibre of the capillaries, would be capable of causing a pumping action on the

[1] A. W. Wellings, "Some Points in the Anatomy of the Capillary of the Tooth Pulp," *Proc. Roy. Soc. Med.*, 1926, xix (Sect. of Odont.), p. 27.

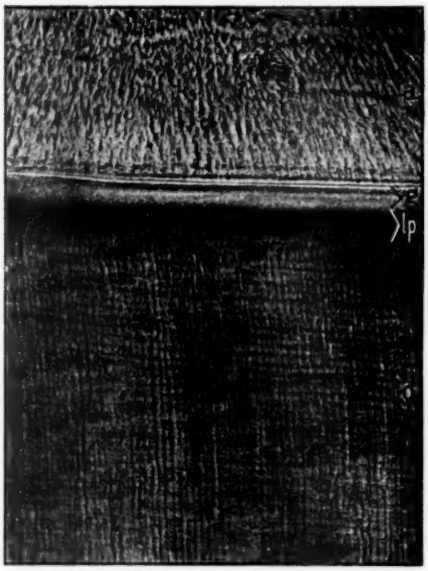

FIG. 7.—Photomicrograph. L.S. canine of dog. Ferri et ammon. cit. solution introduced into pulp one hour before killing animal. Section immersed in potassium ferrocyanide and HCl. Photographed through a red screen, hence the shading represents the depth of the blue colour which in turn indicates the presence of lymph carrying the iron solution. The lymph plexus is seen as a dark band immediately under the granular layer of Tomes, which is relatively free from lymph. *a.*, alveolus; *g.*, granular layer of Tomes; *lp.*, lymph plexus; *d.*, dentine. (2/3 in. objective.)

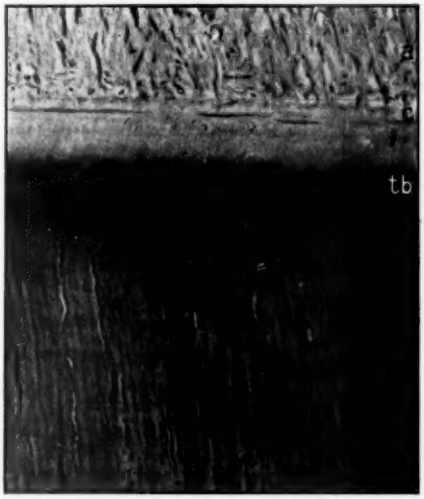

FIG. 8.—Photomicrograph. L.S. canine of dog. Prepared and photographed as in fig. 7. This section shows the accumulation of lymph in the lymph plexus, which is seen to be formed of the terminal branches of the tubules. *a.*, alveolus; *c.*, cement; *tb.*, terminal branches of the tubules; *d.*, dentine. (1/6 in. objective.)

tubules. It is difficult to see what other function these cells could have, while on the other hand they appear to be perfectly adapted to serve this special purpose, particularly as their action is controlled and regulated by the nervous system. The circulation would, therefore, be in the nature of an "ebb and flow," and would not always be in the same direction in a given tubule.

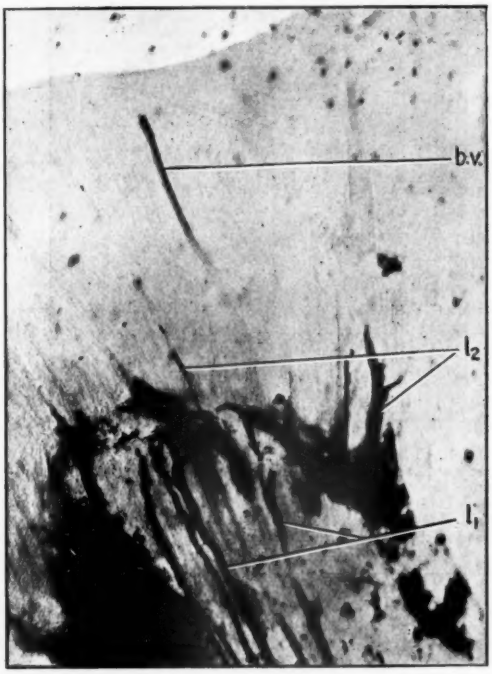

FIG. 9.—Photomicrograph. Longitudinal section of canine of dog, apical portion. Indian ink introduced one hour before animal was killed. l_1, lymphatic vessels in pulp; l_2, lymphatic vessels in canals in dentine; *b.v.*, blood-vessel in canal in dentine. (1 in. objective.)

PART II.

THE CALCIUM CONTENT OF DENTINE: PHYSIOLOGICAL AND PATHOLOGICAL VARIATIONS.

In the light of the observations recorded in Part I, it seemed natural to inquire into the purposes which the lymphatic circulation serves in the metabolic processes of the dentine. As a working basis we may perhaps suppose that the fibril exerts a controlling action on the metabolism of this tissue, while the lymph supplies the necessary materials and carries away the waste products. For the purpose of a preliminary investigation calcium was selected as the particular constituent of the dentine upon which to make determinations, and a fairly large series of analyses have now been made.

Estimation of Calcium: Method.—Specimens of dentine were prepared on a uniform plan from a number of human teeth extracted in dental practice. A transverse section of the tooth was taken, about 2 mm. thick, from the cervical region. This was mechanically

freed from cementum and enamel and the pulp canal was cleaned out, leaving a ring of dentine comprising the outer and therefore oldest part of the dentine in each case. The specimen was then dried at 105° C. for eighteen hours and weighed into a silica crucible. This was taken as the dry weight of the tooth, upon which percentage calculations were based, and does not vary appreciably however long the tooth is dried. To determine this a tooth was dried and weighed at intervals, thus :—

Weight after 18 hours drying ...	...	...	0·2217 grm.
,, ,, additional 6 hours drying		...	0·2211 ,,
,, ,, ,, 16 ,,	,, ...	...	0·2214 ,,
,, ,, ,, 3 days	,, ...	...	0·2213 ,,

After being weighed the tooth was incinerated to a clean white ash. To the ash was added 10 c.c. phosphoric acid solution (1 vol. syrupy H_3PO_4 to 3 vols. H_2O), and on warming the ash completely dissolved. The solution was washed out into a beaker with 50-100 c.c. of water, and 50 c.c. of a solution of oxalic acid containing 37·8 grm. oxalic acid per litre was added. To effect complete precipitation an equivalent quantity of ammonia was added (50 c.c. of solution containing 10·2 grm. NH_3 per litre). The precipitated solution was allowed to stand for a few hours and was then filtered through a sugar tube prepared with asbestos. The precipitate was washed seven times with hot water to remove all ammonium oxalate and the precipitate and the asbestos transferred to a beaker. Ten c.c. H_2SO_4 solution (1 vol. H_2SO_4 to 1 vol. H_2O) were added and the solution heated nearly to boiling. It was then titrated with N/10 potassium permanganate solution. A titration was performed on an equal quantity of asbestos and H_2SO_4 as a small quantity of $KMnO_4$ is absorbed.

Calculation.—One c.c. N/10 $KMnO_4$ is equivalent to 0·0028 grm. CaO. The titration was therefore multiplied by 0·0028, the result being the amount of CaO in the tooth taken. The percentage was obtained by multiplying by 100 and dividing by the dry weight of the tooth. To calculate the percentage of calcium salts contained in the dentine it may be assumed that they occur as nine parts of calcium hydroxyapatite to one part of calcium carbonate, hence 1 per cent. of calcium oxide is equivalent to 1·82 per cent. of the mixed salts.

It was found that the specimens lost from 8 to 10 per cent. of water during the drying process. It was noticed that the percentage of ash obtained from the dentine was no criterion of the amount of calcium contained in it. This would account for the somewhat conflicting results obtained by certain earlier investigators.

The results of these analyses are tabulated below in four groups: premolars, molars, canines and incisors. The specimens in each group are arranged according to age.

PREMOLARS.

No.	Sex	Age	CaO per cent.		Notes
1	F	9	35·5	$\overline{\lvert 4}$	
2	F	9	37·15	$\overline{\lvert 4}$	
3	F	10	36·9	$\underline{4\rvert}$	
4	M	11	35·76	$\underline{4\rvert}$	Open apex
5	M	11	36·63	$\overline{4\rvert}$	
6	F	12	37·05	$\overline{4\rvert}$	
7	F	13	36·78	$\overline{\lvert 5}$	
8	F	13	37·52	$\overline{4\rvert}$	
9	F	13	36·37	$\overline{\lvert 4}$	
10	F	13	37·35	$\underline{4\rvert}$	
11	F	14	37·19	$\underline{5\rvert}$	
12	M	15	37·99	$\underline{5\rvert}$	
13	M	18	38·08	$\overline{\lvert 4}$	Caries
14	F	19	36·36	$\overline{5\rvert}$	,,
15	F	20	37·47	$\overline{\lvert 4}$	,,
16	F	22	38·51	$\overline{\lvert 5}$	,,
17	M	23	36·68	$\underline{4\rvert}$	,,

No.	Sex	Age	CaO per cent.		Notes
				Premolars.	
18	F	30	39·02	$\overline{5}\|$	Same patient
19	F	30	38·92	$\overline{5}\|$	
20	F	30	39·09	$\overline{5}\|$	
21	F	30	38·20	$\overline{5}\|$	
22	F	35	36·73	$\overline{5}\|$	
23	M	35	37·97	$\overline{4}\|$	
24	F	35	38·09	$\overline{5}\|$	Same patient
25	F	35	38·77	$\overline{5}\|$	
26	F	38	38·19	$\overline{5}\|$	
27	F	40	37·32	$\overline{5}\|$	Same patient
28	F	40	38·19	$\overline{5}\|$	
29	F	40	38·20	$\overline{5}\|$	
30	F	45	36·96	$\overline{5}\|$	
31	F	45	38·9	$\overline{4}\|$	Pyorrhœa
32	F	46	38·18	$\overline{5}\|$	Very translucent
33	F	60	38·64	$\overline{5}\|$	Pulp calcified, but cut away before analysis
34	F	62	38·87	$\overline{5}\|$	,, ,, ,,
35	F	70	38·54	$\overline{4}\|$	
				Canines.	
36	F	25	38·49	$\overline{3}\|$	
37	M	27	37·23	$\overline{3}\|$	
38	F	50	41·05	$\overline{3}\|$	
39	M	59	38·7	$\overline{3}\|$	Very firm tooth
40	M	59	39·4	$\overline{3}\|$	
41	F	60	36·5	$\overline{3}\|$	Pyorrhœa, loose
42	F	70	34·68	$\overline{3}\|$	
43	F	70	38·68	$\overline{3}\|$	
44	M	71	37·6	$\overline{3}\|$	
				Molars.	
45	F	11	37·18	$\overline{6}\|$	Caries
46	M	16	37·77	$\overline{6}\|$	,,
47	M	20	38·5	$\overline{6}\|$	,,
48	F	21	40·09	$\overline{6}\|$	,,
49	M	23	36·40	$\overline{6}\|$	,,
50	M	25	38·04	$\overline{8}\|$	,,
51	M	25	37·49	$\overline{7}\|$	Marked absorption of roots. Caries
52	F	25	38·66	$\overline{6}\|$	
53	F	26	37·37	$\overline{6}\|$	Patient neurotic. Endocrine disturbance (?) Caries
54	F	27	37·20	$\overline{6}\|$	Exostosis. Caries
55	M	29	38·9	$\overline{7}\|$	Caries
56	F	35	38·70	$\overline{7}\|$	Eight months pregnant. Caries
57	M	38	38·4	$\overline{6}\|$	
58	F	55	36·50	$\overline{6}\|$	Exostosis
59	F	56	37·33	$\overline{8}\|$	Pyorrhœa. Tooth loose
60	M	60	38·10	$\overline{6}\|$	Marked attrition
				Incisors.	
61	F	50	38·3	$\overline{?}\|$	Root had been crowned for twenty-three years. Good condition
62	M	62	34·30	$\overline{1}\|$	Loose. Tooth fell out
63	F	65	37·78	$\overline{2}\|$	Very translucent
64	F	70	37·80	$\overline{2}\|$	Pulp calcified

An examination of the calcium content of these specimens indicates that the composition of the dentine is not constant. The maximum difference is between Nos. 38 and 62, where the latter contains 6·75 per cent. CaO less than the former. The difference is thus 20 per cent. of the total amount of calcium in the less highly calcified tooth. This finding was not unexpected in view of the extensive irrigation with lymph that the dentine has just been shown to undergo.

The most important positive conclusion that may be drawn is that in a newly-erupted tooth the dentine is not fully calcified, and that for a few years, at any rate, after its complete formation calcium is constantly being carried into the dentine. The average percentage of calcium oxide, and therefore of calcium salts in the premolars, is appreciably lower during the ages 9 to 14 than is the average in premolars from patients of 30 to 45 years of age.

Age of patient		Average per cent. CaO		Average per cent. Ca salts
9-14	...	36·75	...	66·86
30-45	...	38·33	...	69·76

There is, therefore, in the first few years after the eruption of a tooth an increase of calcium salts in the dentine of the order of 5 per cent. of the amount originally laid down at the time of calcification.

Very little indication of a normal physiological reduction in the calcium content of dentine in old age is available, although No. 42 shows a very low reading. Similarly, teeth with pyorrhœa which show great translucency have a normal calcium content, though here again No. 62 is a marked exception. We may perhaps say that there appears to be no insurmountable obstacle in the way of calcium being removed from the dentine, though it does not seem to occur in a high percentage of cases.

The average CaO percentage in badly carious teeth does not appear to be specially low. The carious premolars have an average of 37·42 per cent. CaO, but they are all in the 18-23 age-group, which is intermediate in age between the two groups already summarized. The carious molars also have a normal content of calcium. It may be mentioned in this connexion that the calcium content of the dentine in dogs is appreciably lower than that in human beings, although the dog is naturally immune from dental caries. The table also shows that although young human teeth, which are known to be particularly susceptible to caries, have a low calcium content, yet Nos. 42 and 62, which were taken from the teeth of older people, free from any indication of caries, have the lowest percentage in the whole series. There would therefore appear to be no direct relationship between dental caries and the calcium content of the dentine.

A few general observations may be made: The analyses establish a reliable estimate of the calcium content of dentine, especially as specimens have been analysed in duplicate and have agreed to within ± 0·02 per cent. CaO. Nos. 18 and 19 and Nos. 28 and 29 suggest that symmetrical teeth have an almost identical calcium content, though Nos. 20 and 21 do not bear this out. There does not appear to be any great difference between the calcium content of the different groups of teeth. Adult premolars, molars, canines and incisors all show much the same percentage of lime salts. The only specimen of dentine from a patient in the later months of pregnancy exhibited no deviation from the normal in its calcium content.

PART III.

Preliminary Note on Experimental Procedures leading to Changes in the Calcium Content of Dentine.

When it became apparent that changes occurred in the calcium content of dentine, it was thought to be of interest to attempt to induce modifications experimentally. In recent years much has been said of the influence of the parathyroid on calcium metabolism. Though the interpretations placed by MacCallum on his experimental findings have been freely criticized, yet it has been shown by Erdheim, and later by

Fleischmann, that the parathyroids exerted a definite influence on the calcification of *forming* dentine. It was considered of importance therefore to observe the influence of parathyroidectomy upon dentine which was *already formed*, since it seemed possible that the operation might cause a reduction in its calcium content. A number of cats were accordingly subjected to partial parathyroidectomy. In the experiments tabulated below, the cats used were as follows:—

Cat 1 was from the same litter as Cat 2. The cats were identical in appearance except for a patch of white in the coat. A third cat of the same litter had to be destroyed because it developed tetany four days after the operation—apparently the whole of the parathyroid tissue had been removed. These three cats were about eight months old and their dentine would normally show a slow increase in calcium from time to time (see control cat—Cat 1). Cat 3 was an older cat. The pulp chamber was reduced to the small dimensions of a fully adult cat, and the calcium content of the dentine would not vary appreciably under normal circumstances in a period of two months (the duration of the experiment). All the cats were females. The following experiments were performed. Cat 1 had a lower canine extracted and two months later was killed and the other canine was extracted. Cat 2 had a lower canine extracted and three of the parathyroid glands were removed and identified microscopically. The cat was kept in the same cage as Cat 1, on normal diet, and two months later was killed and the other lower canine was extracted. Cat 3 had a lower canine extracted and three parathyroids removed and identified microscopically. Two months later the cat was killed and the other canine removed. All three cats recovered from the operation without incident and appeared to be in perfect health throughout the experiment.

On analysis the calcium content of the dentine was as follows:—

Cat No.	Operation	Per cent. CaO in dentine at beginning of experiment	Per cent. CaO in dentine at end of experiment	Difference Per cent. CaO	Difference Per cent. CaO salts
1	Control	35·96	36·25	+ 0·29	+ 0·53
2	Partial parathyroidectomy	37·14	36·65	− 0·49	− 0·89
3	Partial parathyroidectomy	38·35	37·48	− 0·87	− 1·58

It will be seen that there was a loss of calcium in both cats upon which partial parathryoidectomy had been performed, while Cat 1, which was a close control of Cat 2, showed the normal increase in the calcium content of the dentine. Cat 3 might have been expected to remain constant apart from the parathyroidectomy.

A second series of experiments was performed to observe the effect of pregnancy and calcium-deficient diet upon the calcium content of adult dentine. Four different types of operation by way of experiment or control were undertaken. In each case young adult bitches were used, the pregnant ones were primiparæ. The first control was to compare the calcium content of the two upper canines extracted at the same time from one of the bitches; this was the same animal as was used for Experiment V.

		Percentage CaO	Difference Percentage CaO	Difference Percentage Ca-salts
Experiment I	$\overline{C}$ | extracted at the same time	35·00	+ 0·08	+ 0·15
	| $\underline{C}$ extracted at the same time	35·08		

The next control was to compare the calcium content of the lower canines of a young adult non-pregnant bitch at an interval of two months (normal duration of pregnancy) on ordinary diet:—

		Percentage CaO	Difference Percentage CaO	Difference Percentage Ca-salts
Experiment II	$\overline{C}$ At beginning of experiment	34·23	+ 1·14	+ 2·07
	$\underline{C}$ | Two months later, normal diet	35·37		

The next experiment was to place a young adult non-pregnant bitch on a calcium deficient diet for two months and compare the calcium content of the dentine of the lower canines before and after.

The diet consisted of meat and polished rice boiled in distilled water. The broth was discarded and the "pith" moistened with fresh distilled water. Distilled water was given to drink with a trace of NaCl added.

			Percentage CaO	Difference Percentage CaO	Difference Percentage Ca-salts
Experiment III	$\overline{C}$	At beginning of experiment	35.79	+ 0·11 ...	+ 0·20
	$\overline{C}$	After Ca-deficient diet for two months	35·90		

Finally, two young adult pregnant bitches were placed on calcium free diet (as above) from the commencement of pregnancy and the calcium content of the dentine of the lower canines compared by extracting one at the commencement of pregnancy and the other at the end of pregnancy:—

			Percentage CaO	Difference Percentage CaO	Difference Percentage Ca-salts
Experiment IV	$\overline{C}$	At beginning of pregnancy	35·76	+ 0·60 ...	+ 1·09
	$\overline{C}$	At end of pregnancy, with Ca-deficiency	36·36		

			Percentage CaO	Difference Percentage CaO	Difference Percentage Ca-salts
Experiment V	$\overline{C}$	At beginning of pregnancy	35·68	- 0·32 ...	- 0·58
	$\overline{C}$	At end of pregnancy, with Ca-deficiency	35·36		

The bitches kept perfectly healthy on the diet except that one (a pregnant one) appeared rather lean at the end of pregnancy, although she fed the puppies for two weeks while still on the deficient diet, All the puppies were born alive at full term.

The observations one may make are as follows:—

(*i*) The calcium content of the symmetrical teeth extracted at the same time in Experiment I shows so little variation that it seems reasonably safe to use symmetrical teeth as controls for experiment (see also Nos. 18, 19, and 20, 21 and 28, 29 in the table of human analyses). There is of course occasionally some possibility of error here.

(*ii*) The increase of CaO percentage of the dentine in Experiment II shows that this normal increase due to lapse of time in young adult bitches must be taken into account in all experiments. (See similar increase in table of human analyses referred to above.)

(*iii*) The effect of the calcium deficient diet in Experiment III appears to be to reduce the increase in calcium which normally occurs.

(*iv*) Experiments IV and V, in which pregnant bitches were fed on a calcium free diet, may be considered separately. The animal in Experiment IV shows a definitely smaller increase in the calcium content of the dentine than the control dog in Experiment II. In Experiment V the bitch appears to have actually withdrawn calcium from its dentine. This loss is of considerable interest, in view of the increase observed in the control (Experiment II), and in view of the fact that it indicates the physiological possibility of calcium being withdrawn from the dentine under stress of calcium starvation.

In presenting these preliminary experiments on the influence of parathyroidectomy and pregnancy on the calcium content of the dentine, it is only intended to indicate the lines upon which the investigation is proceeding. The results so far obtained, however, are so definite that it was felt to be of interest to present them in conjunction with the earlier sections of this paper.

In conclusion, I wish to thank Professor D. T. Harris and Professor J. C. Drummond for their advice and help in the investigations, and to express my thanks to the Dental Board for their grant towards the expenses of this research.

SUMMARY.

(1) Indian ink introduced without pressure into the dental pulp during life is carried up the dentinal tubules into the middle third of the dentine in one hour. From this it is evident that there is a stream of lymph of considerable volume along each tubule, and transverse sections of the ink-bearing tubules make it clear that this stream occupies a space between the fibril and the wall of the tubule (figs. 3 to 6).

(2) When a solution of ferrous ammonium citrate is introduced into the pulp instead of indian ink, the solution may be traced throughout the dentine and detected by staining with potassium ferrocyanide, in a zone just under the cement where the terminal branches of the tubules occur. These branches appear to form a plexus from which the greater part of the lymph finds its way back along neighbouring tubules to the lymphatics draining the pulp (figs. 7 and 8).

(3) This circulation is presumed to be maintained by means of the controlled action of the Rouget cells alternately contracting and expanding the capillaries of the vascular network at the periphery of the pulp.

(4) Lymph vessels in the apical portion of the pulp have been demonstrated and are shown, heavily charged with ink, making their exit through the wide apical canals of the tooth (fig. 9).

(5) A series of sixty-four calcium estimations on human dentine show that the calcium content (estimated as calcium oxide) of dried dentine may vary from 34·30 per cent. to 41·05 per cent., which represents a range in the percentage of calcium salts of from 62·43 per cent. to 74·71 per cent., that is, 12·28 per cent difference, and is almost 20 per cent. of the total calcium in the less highly-calcified tooth.

(6) There is a rapid increase in the percentage of the dentine calcium during the first few years after the eruption of the tooth, due to normal physiological processes.

(7) The dentine of carious teeth, compared with that of healthy teeth, does not appear to be deficient in calcium.

(8) There appears to have been a definite loss of calcium from the dentine in isolated cases of old age and marked chronic periodontal disease, though this was not generally observed.

(9) There does not appear to be any clearly defined difference between the calcium content of the different varieties of teeth—the molars, premolars, canines, and incisors.

(10) Partial parathyroidectomy in cats appears to cause a withdrawal of calcium salts from the dentine.

(11) A calcium deficient diet in young dogs appears to arrest partially the normal increase in the calcium content of the dentine.

(12) A calcium deficient diet in young pregnant bitches appears in one case to have partially arrested the normal increase in the calcium content of the dentine and in another to have caused an actual withdrawal of calcium salts from the dentine.

Note.—The Discussion on the foregoing paper has been postponed to next Session.

Corrigendum.—In the remarks in Discussion by Mr. J. Lewin Payne (President) on Sir Frank Colyer's paper ("Abnormally Shaped Teeth from the Region of the Premaxilla"), p. 56, line 4 from bottom, and p. 57, line 18 from top, for "germinated" read "gemminated."

Section of Odontology.

President—Mr. J. Lewin Payne, O.B.E., L.R.C.P.Lond., M.R.C.S., L.D.S.Eng.

Do Epithelial Odontomes Increase in Size by their own Tension?

By W. Warwick James, F.R.C.S., L.D.S.Eng.

In the "Report on Odontomes," published by the British Dental Association in 1914, Bland-Sutton's term "epithelial odontome" was used to include the three cystic tumours, dental, dentigerous and multilocular cysts, which arise from the epithelium especially concerned with the development of teeth. Such epithelium for convenience was called dental epithelium.[1]

So closely allied are all three types in their origin and development that many points of consideration apply to each one. The particular point I wish to make is that the increase in size is due to the tension within the cyst and that it ceases when the cyst is opened. I have little doubt that the answer to the question used for the title of this communication would be readily given by many of you in the affirmative. This probability induced me to undertake an investigation into the tension of these cysts. Apparatus was devised for the purpose, in which I was aided by my colleagues, Professor McIntosh and Mr. Counsell, at the Bland-Sutton Institute of the Middlesex Hospital. The apparatus has been improved gradually, but unfortunately lack of suitable material has prevented the pursuit of the subject fully, for although the inquiry has extended over many years, cysts which are large enough, and have not been injured or infected, seem to be comparatively rare.

Our investigations show undoubtedly that the tension is higher, in some cases considerably higher, than the capillary blood-pressure, but our methods have not been sufficiently accurate for a statement to be made of the exact tension. Leonard Hill [1] has determined the blood-pressure in capillaries to be about 3·5 cm. of water. One of our cysts recorded over 100 cm. of water and 12 cm. was the lowest record.

I will not trouble you with details of the apparatus. A special cannula was found necessary, as in our earlier experiments the needle became choked or sufficiently obstructed to prevent a quite accurate record. A semi-fluid nature of the contents of many cysts is commonly observed, whilst isolated degenerated cells are readily found microscopically [2 and 3]. The improved cannula (fig. 1) has an opening at one side, which is closed when inserted and opened by rotating an inner tube with a hole to correspond with that in the outer tube. The manometer with a mercury U tube was employed in most cases, but an aneroid type was also used.

[1] The Committee responsible for the Report wished to keep closely to the classification of Bland-Sutton and so extended his group, so well named, to include the three cysts arising from the dental epithelium. "Cystic odontomes" was suggested at the time and probably would have been better, as some confusion may arise from the alternative uses of "epithelial odontomes."

In making a record many factors needed to be kept in mind, such as the level of the cyst and the manometer, an elevation of one over the other giving an inaccurate reading. The apparatus used can be examined and drawings have been made for the epidiascope, also sections for the microscopical examination have been put up. One of the latter shows the point of the junction between the epithelial lining and granulation tissue.

The ætiology of tumours is obscure and is discussed by Kettle in his excellent monograph upon the "Pathology of Tumours." Amongst the many factors the rôle of irritation is important. The cells giving rise to the particular cysts under consideration proliferate as the result of a stimulus associated with changes in the surrounding tissues, induced most frequently by chronic infection—a general statement applying almost certainly to the dental and multilocular varieties and quite possibly to the dentigerous cyst as well.

It is quite clear that proliferation of the cells occurs and that degeneration supervenes, so that a peripheral layer of active cells is present, surrounding a central fluid or semi-fluid area of degenerated cells. Usually a single cavity is present in the dental and dentigerous cysts, whilst innumerable cavities are found in the multilocular variety. It has been argued that the cells degenerate because the nutriment necessary to their existence is cut off. This may be an important factor, but another of perhaps greater importance would seem to be that the life history of the cell is

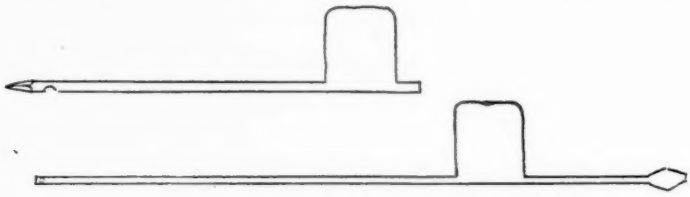

Fig. 1

completed. Very little is known of the life history of the cells in the body; nevertheless the duration of the life of a red corpuscle has been determined, and it is probable that a definite period of life will be estimated for all the cells of the body as our knowledge increases.

The chief interest in the dental epithelium has of necessity resided in connexion with the development of the teeth themselves. It certainly plays a part in their eruption, but after complete eruption we have nothing beyond our histological knowledge. A suggestion has been made that the teeth possess an endocrine function, but although this is a possibility, it is merely a theory. That the duration of life of the cells producing these cysts is the chief factor in degeneration, is supported by the character of a multilocular cyst, where quite minute cysts are found and degenerated cells can be seen enclosed by a single layer of active cells very little removed from a good blood-supply.

The rate of growth of a cyst is significant. The period of time during which one has been noticed is always considerable, and, if the cyst is large, that period may extend into years; in fact it might be said that the size varies approximately with the length of time that it has been present, but growing more rapidly in the early stages. It may be noted that the tension would diminish with the increase in size. The nature of the tissue in which it is situated certainly affects the rapidity of change in size, for once the bone is destroyed, for a short period there would appear to be a greater increase due to less resistance to the tension of the cyst. The globular shape assumed by each cystic cavity might be regarded as proving conclusively that tension exists within it

and also exerts an equal pressure in all directions upon the surrounding tissues. Inequalities of shape are produced by variation in the resistance to the rate of absorption of surrounding structures; for instance, dense bone is absorbed slowly, whilst in the multilocular type there is considerable variation in size of the individual cysts, which may remain massed together, but not infrequently extend along planes of least resistance; such projections, in a sense, become interlocked with the surrounding tissues.

The growing cyst is of an innocent character. The active cells do not infiltrate the surrounding tissues, as occurs in a malignant growth, but they push these tissues aside, causing atrophy with some proliferation, the fibroblasts producing an adventitious capsule, whilst new bone is formed and may continue until the rate of new formation cannot keep pace with the increase in size of the cyst, when perforation of the bony covering results. The thin layer of so-called "expanded bone" over the cyst accounts for the feeling of "egg-shell crackling." The tension within the cyst aids the recoil, so that such feeling is obtained more readily before an opening of the cyst into the mouth has occurred. Mr. Sprawson [4] pointed out that the cells in some cysts presented a more flattened appearance than in others; he observed this in dental cysts. I attribute this flattening to the degree of tension, and consider that where the tension is high the cells become more flattened. This statement one should be able to corroborate.

Cysts are found which do not possess an epithelial lining. Some of these have been regarded as cavities in the bone resulting from infective processes which lead to destruction without sufficient new formation to occupy the area destroyed. It is difficult to conceive that with the cessation of suppuration the cavity does not become occupied by organized granulation tissue. Mr. Mummery [5] recently recorded a multilocular cyst, a case of Mr. Pitts, in which the large cavities were not lined with epithelium. Those cavities which can be regarded definitely as cysts were lined at one time, partly if not wholly, by epithelium. It is possible that the cells may have reached their full period of activity and may have degenerated, their life history being complete. Also this may occur partially, small patches being left which remain active. Histological examination will frequently show that active epithelial cells line part of a cyst, whilst the remaining surface is covered by granulation tissue, a condition found in cysts which have become infected. It is also conceivable that as a cyst becomes large the pressure upon the lining cells may induce atrophy in them; also that attenuation of the epithelial lining may be followed by its rupture, when granulation tissue will form on the surface of the intervals produced. The increase in tension may be partly due to osmosis, but the osmotic tension of the contents has not been determined. The blood-colloid tension is given by Leonard Hill as from 25 to 30 mm. of Hg, which will be counteracted in some degree by the colloidal nature of the contents of the cyst.

Doubtless many of you have observed pulsation at the orifice of a cyst which has ruptured externally, the fluid in the orifice advancing and receding with each heart beat. In one case under my care the pulsation was so marked over the whole cyst wall that a tracing was taken by placing a tambour of a polygraph upon it whilst a tracing of the radial pulse was recorded at the same time (fig. 2), kindly taken by Dr. Bedford, of the Middlesex Hospital. I should add that the pulsation was so marked that the opinion was expressed that the wall of the bony cavity must contain one or more arteries of an appreciable size, but I was quite satisfied that the granulation tissue was sufficient to account for the pulsation. This assumption was supported by the absence of undue hæmorrhage after complete removal of the capsule. It would seem that the tension within the cyst causes atrophy of the surrounding tissues at a point where vascular resistance is higher than that of the normal capillary tension. It is conceivable that the expansion of the cyst continues until the reactionary pressure becomes higher, this being due chiefly to the closer association with vessels of greater tension.

The granulation tissue lining the cyst will then be related with such vessels and may account for the marked pulsation. The feebler pulsation of the fluid seen at the orifice of a perforation into a cyst is easily explained by the presence of granulation tissue lining a bony cavity.

A final argument in favour of the view I have advanced is that the cyst when freely opened ceases to increase in size, in fact the cavity will frequently diminish, a clinical aspect of considerable importance of which surgeons have availed themselves.

I have brought this communication before you, partly with the hope that you may be good enough to provide me with more material for investigation. I should be glad to take the cases into the Middlesex Hospital, where the dental surgeons are fortunate enough to have eight beds under their care.

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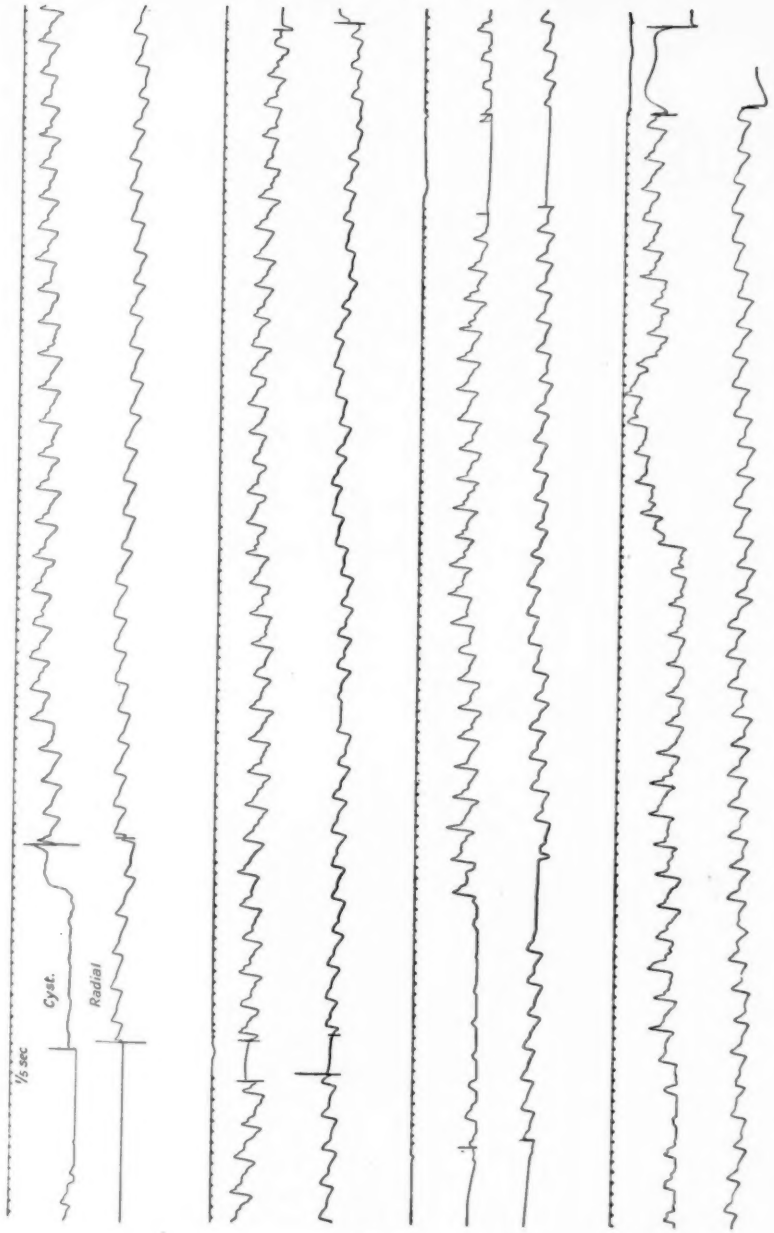

FIG. 2

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OF THE

ROYAL SOCIETY OF MEDICINE

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AND

T. WATTS EDEN, M.D.

UNDER THE DIRECTION OF

THE EDITORIAL COMMITTEE

VOLUME THE NINETEENTH

SESSION 1925-26

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1926

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Section of Ophthalmology.

President—Sir ARNOLD LAWSON, K.B.E., F.R.C.S.

Case of Krukenberg's Spindles.

By J. D. M. CARDELL, F.R.C.S.

PATIENT, a single woman, aged 30, with no family history of myopia, nor of previous inflammation of the eyes. Her corneæ present vertical spindle-shaped pigmentation, symmetrically disposed in each eye, occupying an area of $1\frac{1}{2} \times 3$ mm., and situated below the horizontal meridian. Upon observing the red reflex, the patches of pigmentation can be seen as faint opacities when the pupils are dilated. The pupils react normally to light, the iris is of a grey colour showing no signs of past inflammation and no indication of any persistent pupillary membrane. The right fundus shows no gross changes, but the left eye, which is the more highly myopic, presents an area of choroidal atrophy to the outer side of the disc. The vision of the right is J1 and less than $\frac{6}{60}$, of the left J20 and less than $\frac{6}{60}$, the refraction of the former being -10 D, of the latter -20D.

Miss Mann has examined this case with the slit-lamp, and describes the pigment as being in the posterior layers of the cornea almost on Descemet's membrane and composed of a multitude of closely-set brown rings.

It would appear that, in the absence of any signs of inflammation of the iris past or present, in the difference in colour between the iris and the pigment, and in there being no evidence of a persistent pupillary membrane, the origin of the pigment must be regarded as congenital, probably hæmatogenous, arising primarily in the cornea itself.

Two Cases of Penetrating Wound of the Globe.

By G. H. POOLEY, F.R.C.S.

Case I.—Patient, a farmer, who, in March last, was hedging, when a thorny branch sprang back and a thorn penetrated the sclera on the outer side of the left cornea, passing into the ciliary body. An attempt had previously been made locally to remove the thorn but it was unsuccessful, as the thorn broke off short. A few days later the wound became septic, and a hypopyon was set up; this filled the whole of the lower half of the anterior chamber. I excised all the septic scleral area, and washed out the wound in the globe with 1 in 1,000 acriflavine in normal saline; after that the whole of the hypopyon disappeared. I put three catgut sutures into the sclera, invaginating the edges, and cutting away a piece of conjunctiva on one side. Then I brought over a conjunctival flap which I sutured with catgut, and the man made a satisfactory recovery; there was no keratitis punctata, and vision is now $\frac{6}{12}$.

Case II.—This occurred more recently. On August 4 a glass gauge broke and a piece of glass entered the left eye, making an incision 3 mm. long in the cornea and 9 or 10 mm. in the sclera. Vitreous was showing. Three scleral sutures brought the edges of the sclera together, and a conjunctival flap was brought over. There was now no keratitis punctata; the eye was fairly quiet, and he could see $\frac{6}{18}$. There might still be a small piece of glass in the eye. The case illustrates my method of scleral suture.

Case of Penetrating Injury of the Eyeball.

By R. Lindsay Rea, F.R.C.S.

The eye of this patient was penetrated by a piece of china a week before I saw him. In the wound there was iris and a large piece of anterior capsule. A hypopyon was present, and there was no reflex from the vitreous. Dr. Batten was the only colleague who advised waiting before doing anything operative. Two skiagrams were taken, but both proved negative. While the man rested in bed and after his eye had been treated with hot bathing and by other careful methods the hypopyon disappeared. I was then able to divide the iris and piece of capsule, and the vitreous afterwards began to clear up. The lens had not become opaque, most probably on account of the polygonal epithelium remaining attached to the lens when the more superficial part of the capsule was ruptured, the aqueous fluid thus not being brought into contact with the lens fibres.

The vision of the injured eye was now $\frac{6}{12}$, that of the other being $\frac{6}{12}$.

Two Specimens of Foreign Body in the Eye.

Shown by J. Gray Clegg, F.R.C.S.

(1) *A piece of Iron embedded at the Ora Serrata for Eighteen Years before Removal of the Eye.*

(2) *A Semilunar Fragment of the end of a Steel Punch.*—Although the foreign body measures 25 mm. it was completely buried in the scleral cavity, and only on the application of a magnet was its presence revealed.

DISCUSSION ON PENETRATING INJURIES OF THE EYE.

Mr. J. Gray Clegg.

During my term of office as Honorary Surgeon at the Royal Eye Hospital, Manchester, i.e., to the end of 1924, a period of twenty-five years, I have had 212,985 accident cases. Of these 1,448 have been admitted as in-patients under my care, including 859 cases of penetration or rupture of the globe.

In all cases it is most important to go carefully and fully into the history of the accident. One must determine definitely whether complete penetration has taken place and, secondly, whether the mechanical agent that has caused the damage has been withdrawn from, or remains in, the eye or adjacent tissues. The depth of penetration must if possible be ascertained.

Actual perforation can often be proved by the slit lamp to have taken place. If the ordinary methods of examination fail to convince, examination by the slit lamp will frequently show that actual perforation has taken place. If the wound of the cornea be small and aseptic no active surgical treatment is required.

When prolapse of the iris occurs there are three courses open: (1) Reposition through the wound; (2) reposition by the method of Chalmers Watson; (3) excision of the prolapsed portion—the usual method followed.

If excision of the prolapse is determined on, in order to grasp the iris tissue without merely tearing it, I advocate, in suitable cases, the use of small fine-ribbed capsule forceps in place of the ordinary one-into-two-toothed-iris forceps, especially if the excision has to be undertaken when the iris has become friable from inflammatory changes.

If the corneal wound is large and tends to gape it may be sutured, using the special split-ring forceps of Webster Fox. For suture material the employment of either horse hair or the finest silk-worm gut is advisable.

If the sutures are passed across the surface of the cornea, do they damage its surface?

Not infrequently the damaged eye is not seen until several days have elapsed after the infliction of the injury, and the question may arise, is it better actively to interfere at once or to postpone dealing with the prolapse and adhesion of the iris to the cornea until after the traumatic inflammation has subsided?

Each case will have to be judged on its own merits.

Wounds of Lens.

Wounds of the lens, as associated with penetration of the globe, always complicate matters if there is any more than a mere fine tear in the capsule, not big enough to allow aqueous to invade the substance.

Is it advisable to remove the lens substance when there is a recent wound of the cornea and by what methods, e.g., (*a*) extraction, if the patient possesses a hard nucleus; (*b*) expression through the original wound or through a surgical fresh incision; (*c*) lavage, or suction of soft cortex? I think that one or other of these methods is justifiable in some cases where there is an extensive rupture of the capsule, for the presence of the lens substance in the anterior chamber increases the possibility of sepsis, diminishes the osmosis at the filtration angle and may in susceptible patients lead to endophthalmitis phako-anaphylactica. On the other hand, when the corneal wound is not large and the lens substance is not greatly swollen nor projecting into the anterior chamber, the removal of the lens can be left to absorption in a young subject or to a later extraction in an individual over thirty years of age.

If vitreous protrudes into the anterior chamber the case is still more complicated. Little can be done actively except when it prolapses through the corneal wound; under these circumstances the prolapse should be snipped off and the eye, as in all cases, protected against infection. Even such a complication does not absolutely involve the loss of the eye.

Scleral and Corneo-Scleral Wounds.

When the wound is at the corneo-scleral junction or in the sclera the case is, in a way, more serious. If the ciliary body or the choroid is prolapsed it cannot be replaced and the only procedure is excision. The same applies to vitreous prolapse.

Even large, clean wounds of the sclera may heal well and a useful eye be retained. Covering with conjunctiva is very desirable, practically in all cases. In some cases this procedure may have to follow suturing the sclera; but the latter is necessary only if the wound is large and tends to gape.

In all extensive perforating wounds of the globe one has to consider whether recovery is possible with retention of a globe that will possess some degree of useful sight and one that is not a threat to the fellow eye. The recuperative power of nature is so great that in my opinion it is very rarely wise to condemn an eye to evisceration or excision as soon as first seen. I practically always give the eye a chance, whether immediate operation in the way of cleaning up prolapse, &c., is required or not; and I am of the opinion that many an eye can be saved if a week at least is allowed to pass before the eye is condemned. There is practically no fear of sympathetic trouble arising if the eye is left for a week, the earliest date recorded of that dreadful condition arising is four days, but up to a fortnight may be allowed if there appears to be a good chance of saving a useful organ.

Foreign Bodies in the Globe.

So far I have only mentioned the possibility of a foreign body penetrating and remaining in the globe. Foreign bodies are readily divisible into two groups: (1) non-magnetic, and (2) magnetic; both of these are further subdivided into (1) radio-opaque, and (2) radio-transparent. Of these, the radio-opaque can be accurately localized, either by the Mackenzie Davidson or the Sweet method.

When the foreign body is in the anterior part of the globe the bone-free method recently suggested is very accurate and more efficient if the fragment be minute.

The question arises in the case of the non-magnetic foreign body as to whether more damage will be done by an attempt at removal or by leaving it alone. Such substances as are non-irritating may under some circumstances be left—glass, for instance. Other chemically inert substances are very rarely found in the eye.

The action of chemically irritating, non-magnetic material, e.g., copper, eventually leads to loss of the globe, and under these conditions even heroic efforts must be made to remove it. Fortunately, the greatest number of foreign bodies met with are radio-opaque and magnetic, and the magnetic force is available as a help in their extraction.

There is another condition not infrequently found, in which there is only a minute opening, sometimes not even discoverable, in the cornea-scleral junction or in the sclera, with a clear lens and a foreign body in the vitreous. There are two schools of practice, and opinions are invited as to the relative value of the posterior and the anterior routes.

The great advantage of avoiding the risk of damaging the lens capsule and so of bringing about a cataract is in favour of the posterior route. Its drawbacks are the greater risk of septic infection, the entanglement of retina and choroid in the opening and the later possibility of detachment of the retina. I must say that so far I have usually chosen the anterior route.

Mr. G. H. Pooley.

I have come to the conclusion that we are justified in treating penetrating wounds of the eye by conservative methods and in trying to adopt a modified modern surgical technique to the eye. I do not regard accidental penetrating wounds of the eye as extremely dangerous, even mild forms of sepsis may be successfully dealt with; a quiet, blind eye is better for the owner than an artificial one. It is surprising how seldom these accidental wounds, when caused by glass or steel, become septic; wounds inflicted by thorns or stones from the roads are more frequently infected, as is only to be expected.

Penetrating wounds of the eye may be classified as follows:—

(1) Penetrating wounds of the cornea or sclera or both: (*a*) without prolapse of iris or other tissue and without the retention of a foreign body or injury to the lens; (*b*) with prolapse of iris or other tissue, without the retention of a foreign body or injury to the lens; (*c*) with or without prolapse of iris or other tissue, or injury to the lens, but with the retention of a foreign body within the eye; (*d*) the above, with injury to the lens.

(*a*) *Wounds in the sclera* can be successfully closed by sutures of the finest thirty-day catgut. They should be inserted in the same way as Lembert sutures are inserted in the intestine, i.e., they should pick up the outer layers of the sclera about 1 to 2 mm. from the wound on each side and be tied so as to invaginate the cut edges of the sclera and hold them in apposition, but not too tightly. The conjunctiva should be sutured over with catgut so as to bury the sutures.

A gaping corneal wound can be kept in place by indirect suture, i.e., a needle is made to pick up the conjunctiva and a few strands of sclera and then carried across the cornea at right angles to the wound, and the conjunctiva and sclera picked up on the other side of the cornea.

In the case of dirty, contused wounds which fail to fit together accurately, a very cautious and judicious paring of the edges, with the removal of any badly damaged or dirty tissue, is justifiable so long as the operator is careful to leave edges that can be brought into accurate approximation without undue tension. It is perfectly possible to remove a diamond-shaped piece of sclera and to bring the edges together successfully and so to save an eye.

(*b*) *Prolapse of the Iris.*—The prolapsed portion of the iris should be picked up, gently pulled a little further out of the wound and cut off. Prolapsed portions of the ciliary body, choroid or retina, should also be cut away, also prolapsed beads of vitreous; these latter only after the sutures have been tied.

(*c*) *Foreign Bodies.*—These should be removed by the nearest and easiest route, either by the original wound or by a fresh incision at the nearest convenient spot to the foreign body in cornea or sclera, and the wound dealt with as already stated. If the foreign body is aseptic it can be retained for a long time without causing any trouble, e.g., particles of coal embedded in the lens, bits of steel or glass in the vitreous, &c.; if septic they will leave a septic track behind even if removed quite soon. While there is no need to hurry for a few days, so that foreign bodies can be localized properly, they should be removed as soon as this can be conveniently done, although I have successfully removed pieces of glass which had been retained for several years, and steel which had been retained for more than twenty years.

(*d*) *Injuries to the Lens.*—Where there is an extensive wound of the capsule of the lens with a fairly large corneal or sclero-corneal wound, after dealing with the iris if prolapsed, insert any necessary sutures; but before tying them, if possible well wash out and remove as much of the injured lens as you can to prevent it from swelling up and adhering to the wound afterwards.

Sympathetic Ophthalmia.

This little-understood disease varies very much in the severity of its onset. The most severe type manifests itself as an intense uveitis with exuberant plastic exudate on the iris. In my experience sympathetic ophthalmia has never followed a penetrating wound of the sclera, even when a foreign body was retained in the vitreous. I have seen panophthalmitis, I have seen shrinking, but not sympathetic ophthalmia. I have made a great many penetrating wounds in the sclera in order to remove intra-ocular foreign bodies. In practically every case of sympathetic ophthalmia which I have seen there has been an injury to the iris, either a neglected prolapse of the iris—the commonest cause in my own experience—or some bruising of the iris. Sympathetic ophthalmia has followed two operations for extraction of the lens, in one of which the eye operated upon has only a few spots of keratitis punctata, and yet normal sight with glasses has been obtained and retained. In the other case the patient was very restless and mental symptoms followed; he obtained $\frac{6}{12}$ vision with a glass as a result. I had to excise the sympathizing eye. Another case of sympathetic ophthalmia occurred after washing out a lens in a very restless patient; a good deal of iris pigment had found its way under the conjunctival flap. I had to excise the operated eye, but the sympathizing eye recovered, I removed the lamellar cataract from that eye successfully and he can see well with it. Penetrating wounds of the ciliary body are less serious than those of the iris and are of no special importance. On the whole my opinion may be crystallized as follows:—

No matter how severe the injury never remove the injured eye during the first fortnight; you will be surprised to find how many hopeless-looking eyes recover. In the third week, decide the fate of the injured eye, taking the following factors into consideration:—

(1) The visual acuity of the uninjured eye with a glass, of course, if needed; (2) the amount of visual acuity the injured eye is likely to gain; (3) the general value of each eye to the patient for his vocation in life; (4) the presence or absence of keratitis punctata in the injured eye; (5) the tension of the injured eye.

Technique of Scleral Suture.

(1) *Instruments.*—Those I use are (*a*) a pair of straight iris forceps or the slightly stronger ones I use for operating on glaucoma; (*b*) a sharp Graefe or glaucoma knife for paring the edges of the wounds; (*c*) short, sharp, straight scissors; (*d*) slightly

curved needles, the belly of which is larger than the eye, so that the suture can follow quietly through the hole the needle makes without any tugging or cutting out; (*e*) a pair of needle-holders without any spring catch; (*f*) fine, 30 catgut.

(2) *Asepsis.*—Paint the skin of the eyelids right up to, and including, the eyelashes with methyl violet and brilliant green paint. Cover the patient's face with a sterile cloth with a window in it. Douche the conjunctiva with 1 in 1,000 acriflavine solution in normal saline—this can also be used for washing out lens matter or septic products. The sutures must not be touched by the hand unless gloved, but can be tied with forceps.

Mr. CHARLES GOULDEN

said he only wished to remind Members of the Section of some remarks he made some years ago on the treatment of certain difficult cases of prolapse of the iris, and the treatment of non-magnetic foreign bodies present in the anterior chamber.

The so-called Chalmers-Watson method was to make a small incision opposite the perforation, 3 mm. in width, and large enough to admit a repositor. Then one could deal with the prolapsed iris. If any portion of the iris remained entangled in the wound, one could pass the repositor through the incision and disengage it. He saw Mr. Whiting operate on a good many of these cases some years ago, and that gentleman had a method of trying to get round the under-lip of the valve-shaped wound by using the sharp teeth of an iris forceps as a fishing-hook, so as to catch the piece of iris and pull it through the wound. There were many difficult cases, and that procedure worked satisfactorily in some cases, though he thought the other method was the easier.

With regard to the treatment of large perforating wounds, especially wounds which perforated the sclera, he differed from Mr. Pooley as to the insertion of scleral sutures, as he (Mr. Goulden) thought that was unnecessary, and, from the point of view of loss of vitreous, dangerous. On the other hand he did not see much advantage in it.

The slide he would now show represented a composite wound, which had involved the cornea, the limbus, and the sclera. The conjunctiva was elastic, and therefore it might be pushed aside by some perforating instrument, and then retract over the wound; hence the wound in the sclera might be larger than that in the conjunctiva. He made an incision in the direction of the wound, and he used two small Spencer Wells forceps, which retracted the wound by their own weight; the prolapse of the uvea was dealt with in the usual way, and suturing done through the conjunctiva only, putting in mattress sutures, which he considered preferable to scleral sutures.

In injuries with large, gaping wounds the healing would be difficult, if not impossible. The method of dealing with them was to make an incision round the conjunctiva, then draw the conjunctiva over the wound, and so close the wound.

With regard to the presence of magnetic foreign bodies in the anterior chamber, the illustration shows one important point in regard to their removal by the hand-magnet when the body rested on the iris. The usual practice had been to make an incision at the corneo-scleral margin in the immediate neighbourhood of the foreign body. The slide exhibited shows why that so frequently failed and was associated with entanglement of iris. The incision made with the keratome was never in the plane of the iris, but anterior to that plane. After such an incision was made, and the point of the magnet inserted, the foreign body was frequently found where it could not be reached by the magnet, and even if it was reached, it was wiped off by the posterior edge of the corneal wound. Hence the incision should be made immediately opposite, and the body withdrawn by applying the magnet over the outer surface of the cornea.

Mr. M. H. Whiting

discussed the relative merits of the Haab and Mellinger magnets in the removal of foreign bodies from perforating wounds of the eye. He, in association with many other surgeons, felt that the Haab was the superior instrument. The visibility was better. The rods with the Mellinger magnet were difficult to control and the patient could not withdraw his head when he felt pain; that was the reason why lens injuries were more frequent with the Mellinger magnet. Thirdly, the power of the Haab magnet was greater.

Mr. Elmore Brewerton

remarked that two speakers had mentioned prolapse of iris and its replacement, and they both suggested that an incision should be made 180° from the radial wound. (Drawing shown.) He thought it was much easier to make the incision at 90° or less and he advised that a keratome incision should be made in all such cases before dealing with the prolapse. The repositor was made to enter at the incision and passed between the root of the iris and the prolapse, and by gentle, sweeping movements the iris might be replaced in position even if two or three hours had elapsed since the injury. If the interval was longer the prolapsed part of the iris must be excised before the repositor was used.

Mr. T. Harrison Butler

said that to do the best work both kinds of giant magnet were required, as some cases were more easily dealt with by one and some by the other. He wished to enter a protest against the text-book version, that when once sympathetic ophthalmitis had set in it was of no use to remove the exciting eye. He had generally removed the exciting eye, and if that were done in the early days, many eyes would be saved. It was very important to watch the second eye with the slit-lamp. If there seemed to be any doubt as to an eye threatening danger, he began the treatment for sympathetic ophthalmia before its actual onset, and it was a very useful precaution.

Sir William Lister

asked how Mr. Pooley excised the septic wound in the sclera, and what instrument he used to cut away the sclerotic.

Mr. G. H. Pooley (in reply)

said that for trimming or making scleral wounds he used a very narrow stiff-shanked knife with a short cutting edge. He put that in through the sclera, keeping the point as closely under the sclera as he could, making a ripping movement, and sometimes he used an ordinary pair of specially short squint scissors. With that he could finish the incision.

Section of Ophthalmology.[1]

President—Sir ARNOLD LAWSON, K.B.E., F.R.C.S.

Case of (?) Metastatic Inflammatory Deposit in Cloquet's Canal, in both Eyes.

By M. L. HEPBURN, F.R.C.S.

PATIENT, G. C., female, aged 33.

History.—Came to Royal London Ophthalmic Hospital (Moorfields) under my care, in April, 1923, complaining of misty sight in both eyes following "a poisoned foot and pyorrhœa." Right vision, barely $\frac{6}{60}$. Left vision, barely $\frac{6}{60}$. No improvement in either eye. Pupils equal and act to light. Wassermann and von Pirquet reactions negative.

In neither eye can any view of the fundus be obtained, but there is a white, hazy mass occupying the central part of the vitreous, and apparently connected with the disc behind, as no view of the disc can be obtained in any position of the eyes.

December 11, 1925.—At the present time the fundus can be seen in the periphery quite clearly, but the central part is still occupied by a white mass of organized exudate. The patient says her sight is much improved, but actually it is much the same as it was so far as central vision is concerned. At the same time her colour perception is quite acute.

Case of Retinitis (? Result of Hæmorrhage).

By A. C. HUDSON, F.R.C.S.

PATIENT, P. B., female, aged 11.

History.—Birth believed to have been normal. No illnesses except three attacks of measles. No chest symptoms of any kind. The left eye has always "looked peculiar"; vision found defective at school two years ago. Right eye has vision = $\frac{6}{6}$, and is in all respects normal. Left eye: vision = hand movements.

Left Eye.—In the central region of the fundus, in or behind the retina, is an opaque, white mass, projecting forwards about 5 D. The retinal vessels on its surface and between it and the optic disc are considerably distorted by traction. On the upper inner part of the mass there is a bunch of minute vessels with the appearance of an angeioma: at the lower border of the mass the retina covers or contains a yellowish material, and at the lower inner part there is pigmented material similarly veiled. In the lower inner periphery of the fundus a small white mass projects forwards from an area of retinal pigment disturbance. Strands pass horizontally outwards through the vitreous from this white mass to a similar one lying more directly below the optic disc. A fairly large retinal vein is directly related to each of these foci. The case has been under observation for two years, and during this time there has been no change in the appearance of the fundus.

Sir ARNOLD LAWSON (President) said that hæmorrhages in the retina in children were not very uncommon. He recalled a bad case of it in a boy aged 15, whose retinal hæmorrhages were due to masturbation; the hæmorrhages were in only one eye. There were many white scars in the fundus at the time, and he thought these represented decolorized clot. After the boy had ceased from the habit the retinal condition cleared up.

[1] Clinical Meeting held at St. Thomas' Hospital, December 11, 1925

Cases of Central Retinitis.

By A. C. Hudson, F.R.C.S.

Case I.—Patient, W. G., male, aged 43. Occupation, fitter. Duration of the disease five years.

History.—Shown to the Ophthalmological Society U. K., April 1921, when the vision of the right eye had been noticed to be defective for five months. During this time the case had been under observation, and vision had deteriorated from $\frac{6}{9}$ to $\frac{6}{24}$, and subsequently improved to $\frac{6}{6}$ partly. At the first examination there was only slight œdema of the retina, above and to the inner side of the macula; the appearance of the fundus in the macular region at a later date was extremely similar to that of the right eye of L. W., shown to-day. The left eye was normal. No cause could be assigned for the retinal disease.

Right eye.—Vision = $\frac{6}{6}$; no colour scotoma. At the fovea is a collection of pigment surrounded by a depigmented area. Beyond this the fundus reflex appears of an abnormally dark hue, suggesting excess of pigment in the epithelium. This dark red area has an average diameter of about 2 optic discs, and is surrounded by a partially depigmented zone containing some clumps of pigment.

Left eye.—Vision $\frac{6}{6}$. Fundus normal.

Case II.—Patient, L. W., male, aged 41. Occupation, sorter in General Post Office. Duration of disease ten weeks.

History.—Since 1918 has had attacks of severe pain at back of right eye and in right temple lasting about three quarters of an hour, about twice a day, over periods of six weeks or so, at intervals of about three months. All teeth removed for pyorrhœa in 1920 and 1921; had neuritis in left arm in 1921. No history of nose or throat disease, and no severe gastro-intestinal symptoms. No history of venereal disease. Wassermann reaction negative (Dr. Browning). Urine: no albumin and no sugar. Result of examination of nose and throat: nasal septum deflected to right (Mr. Hett). Skiagrams show that the left antrum and left ethmoidal sinuses are not as clear as on the right side (Dr. A. Bowie). Right vision noticed to be defective for ten weeks; objects appear to be seen through a green veil.

Right eye.—H. M. 1 D. = $\frac{6}{9}$ (4 letters); central scotoma for red. The retina of the macular region has an opaque appearance, possibly attributable to a diffuse thickening of Bruch's membrane. At the upper border of the involved area there is mottled pigmentation from disturbance of retinal pigment epithelium, and throughout its most central part are numerous minute, sharply defined, yellowish-white spots. The blood-vessels are healthy.

Left eye.—H. M. 1·5 D. = $\frac{6}{6}$. There is a small area above the macula with the appearance of colloid hypertrophy of Bruch's membrane and irregular pigmentation, and a spot of rather similar appearance a short distance external to, and below, the macula.

These two patients exemplify what I believe to be a type of retinitis with characteristic ophthalmoscopic features at an early stage, dependent on an opaque appearance of the retina in the macular region with more or less disturbance of retinal pigment, and the presence of minute yellowish-white spots, situated chiefly in the most central part of the involved area.

One of the cases exhibits a sequel of the typical early fundus changes exemplified by the other. The condition as I have seen it has usually been unilateral, but both eyes may be involved. Several of the patients have stated that objects appear to be seen through a violet or green veil, and there may be a central colour scotoma. In several cases I have suspected air sinus inflammation, tonsillitis, or dental sepsis as the cause of the condition.

Case of Ichthyosis of the Skin, with Ectropion.

By A. C. HUDSON, F.R.C.S.

PATIENT, G. W., male.

History.—Ichthyosis of skin since birth. Ectropion of lower lids with exposure of corneæ. Right eye: xerosis of conjunctiva and cornea. Left eye: chronic keratitis involving lower part of cornea. Vision: counts fingers at 1 metre.

January 21, 1925.—Thiersch graft taken from outer side of arm applied to horizontal incision in left lower lid.

In spite of the very abnormal condition of the skin used for the graft this has survived and has assisted in considerably reducing the deformity.

This case appeared to me suitable for a Thiersch graft, but it seemed very questionable whether the patient's own skin, being so very abnormal, would take as a graft. A thin skin graft was taken from the outer surface of the arm. Although it had almost the consistency of parchment, and looked white and dead, it took very well. It has shrunk somewhat now, but the condition is very much better than before the operation, and the eye is satisfactorily closed during sleep.

Cases of Black Cataract.

By A. C. HUDSON, F.R.C.S.

Case I.—PATIENT, T. C., aged 65.

History.—November 21, 1924.—Unable to read for many years.

Right eye: Vision: counts fingers at 2 ft.; projection of light accurate. Left eye: vision: counts fingers at 1 ft.; projection of light accurate. In each eye there is a very large reddish-brown lens nucleus.

November 26, 1924.—Right extraction of cataract with peripheral iridectomy.

January 1, 1925.—Right capsulotomy.

January 13, 1925.—Right vision with + 10·5 D. sph. = $\frac{6}{9}$. Fundus normal.

Case II.—Mrs. A. B., aged 62.

History.—February 7, 1923.—Gradual failure of right vision since receiving a blow twenty years ago, and of left vision for about one year. Right eye: pupil active to light, but reaction not well-sustained. Black cataract: no fundus reflex except in centre of pupil, where it is pearly. Vision: perception of light; projection of light very defective. Left eye: pupil active to light. Black cataract: no fundus reflex except in centre of pupil, where it is pearly. Vision: perception of light; projection of light accurate.

March 21, 1923.—Left extraction of cataract with complete iridectomy. Lens was of enormous size and blackish-brown.

April 18, 1923.—Left capsulotomy.

Present Condition.—Left vision: $\frac{6}{18}$ (three letters), not improved by lens. Choroido-retinal degeneration in central region, probably consequent on myopia.

It is said that typical black cataract is usually associated with some sort of disease of deeper parts—hæmorrhage into the vitreous, or high myopia.

In the second of these cases there was high myopia. In the first, however, with typical black cataract, there was a perfectly healthy fundus and no evidence of myopia.

In the second case a very remarkable feature was the pearly grey reflex from the pupil of each eye, under certain conditions of illumination, strongly suggestive of an old detachment of the retina, which was indeed quite probably present in the right eye.

Discussion.—Mr. J. GRAY CLEGG said he removed a black cataract a short time ago. In such cases one saw a peculiar bluish-white sheen in one direction, while when viewed at another angle a brown colour was apparent. He agreed that black cataract might occur in a healthy eye.

Sir ARNOLD LAWSON (President) said that his experience in these cases was similar to that of Mr. Clegg; it had not occurred to him that black cataracts were always associated with impaired vision. He had extracted them.

Case of Neurofibromatosis with Buphthalmos and Keratectasia. Entropion of Lower Lid.

By A. C. HUDSON, F.R.C.S.

PATIENT, N. S., male, aged 24. This man shows the not very uncommon association of buphthalmos with neurofibromatosis of the fifth nerve. Mr. Treacher Collins has found the buphthalmos to be dependent on defective development of the angle of the anterior chamber, not upon any peculiarity of the nerves of the eye.

Case of Cyst of Iris (? Ectodermal Cyst).

By P. G. DOYNE, F.R.C.S.

PATIENT, E. S., female, aged 46. Came to Moorfields on account of difficulty with near work.

Vision, right = $\frac{6}{6}$ }
Vision, left = $\frac{6}{6}$ } With + 1·0 D. sph. read test types readily.

Tension: right and left, normal.

The iris of the right eye was noticed to be slightly bombé down and out, and a dark formation appearing as the chord of the arc of the pupil down and out. On dilatation this formation showed very readily; it appears to be a cyst of the pigment epithelial layers of the iris. The border towards the pupil is rounded and the cyst translucent. It would appear likely that the cyst might be formed by a separation of the two epithelial layers of the iris.

Mr. J. GRAY CLEGG said that he had seen a similar case and that the patient was still under observation. The condition had not changed in appearance during many months. He did not know whether the Members considered that operation should not be undertaken at this stage. Cysts of the iris were not particularly satisfactory to treat, if of traumatic origin. He felt convinced this was a cyst, as transillumination with a strong light showed dull red through the cyst.

Section of Ophthalmology.

President—Sir ARNOLD LAWSON, K.B.E., F.R.C.S.

Operation for Paralytic Strabismus.

By M. L. HEPBURN, F.R.C.S.

PATIENT, female, aged 45.

History.—In May, 1916, had a fall from her horse while hunting. Unconscious for half-hour afterwards; on recovery the left eye was convergent with widely dilated pupils and slight right facial paralysis. The pupils quickly recovered and acted normally the next morning. Three weeks after the accident both eyes were strongly convergent, about 40° in each eye. Movement outwards in both eyes impossible, with the left slightly less movable than the right. Movements in other directions normal. Both pupils acted well to light. Right vision, $\frac{6}{6}$ c. −9 sph. Left vision, $\frac{5}{6}$ c. −9 sph. Fundi normal.

Great discomfort arose from the fact that she was obliged to turn her head to one side or the other into an extreme position in order to see at all, and this caused intense aching of the muscles of the neck.

Hæmorrhage at the base of the brain was diagnosed, and no immediate operative interference was advised in the hope that after absorption of the hæmorrhage recovery might take place spontaneously.

There being no improvement in April, 1917, an advancement operation and tenotomy were undertaken in the right eye on April 28, followed by a similar operation in the left eye on July 11, 1917. Cosmetically the eyes were then straight, the right eye being the straighter of the two, but there was double vision for near and far distance. Her head being straight the muscular discomfort was completely relieved. She then resumed hunting and playing games.

In October, 1924, while playing tennis she was struck in the eye with a tennis ball, and the right eye became markedly convergent again; so on November 5, 1924, I did another advancement operation and tenotomy on the right eye, with the result that now she has no double vision at near range but about 20° prism diplopia in the distance. Cosmetically she appears straight, though there is still practically no movement outwards in either eye beyond the middle line.

Case of Severe Cyclitis.

By M. W. B. OLIVER, M.B., F.R.C.S.

TWO very severe cases of cyclitis are shown. One of them I saw last January (1925), and, in spite of everything I could do for her, she got worse; and at last I sent her to Dr. C. B. Heald, and she had three months of treatment with ultra-violet rays generally and diathermy locally. Within a month she improved greatly, the pain disappeared, and she felt much better, she put on weight, and the eye quieted down. She now has $\frac{6}{6}$ vision in that eye, and there is no sign of active disease there.

The other case was very similar; the patient has put on nearly a stone in weight since the ultra-violet ray treatment. She is now having twenty minutes of the rays three times a week, and diathermy is applied directly to the eye through a pad of cotton wool.

Case of Filament in the Macula.

Shown by F. A. WILLIAMSON-NOBLE, F.R.C.S. (for M. G. PEARSON, F.R.C.S.).

THIS is a case which has been shown by Mr. Pearson. The patient is a high myope, and there has been a lesion of the macula, producing a filament growing into the vitreous. It is a question whether this is some form of aberrant hyaloid artery, or whether it is post-inflammatory and comparable with retinitis proliferans.

Miss IDA C. MANN said she did not think the filament was an aberrant hyaloid artery, because the hyaloid artery was by definition that branch of the arteria ophthalmica interna which entered the eye through the choroidal fissure. It had been proved by Chiewitz and others that no rotation of the eye took place during development and that the macula had no relation to the site of the choroidal fissure. A true hyaloid artery could therefore never enter the eye at the macula, neither were any of its branches—the vasa hyaloidæ propria—normally attached to the macula. The filament in question rather resembled structures sometimes seen in retinitis proliferans.

DISCUSSION ON PLASTIC OPERATIONS ON THE FACE, IN THE REGION OF THE EYE.

(With the Section of Surgery.)

Mr. H. S. SOUTTAR, C.B.E.

IT happened, many years ago, that Dr. Sequeira, of the London Hospital, began sending me cases of hairy mole, and it is astonishing how many cases of hairy moles of the face exist, and how extensive they are. When first I began to deal with these moles I did not realize what the essential difficulty is in treating them: the difficulty is in the surgery of the region around the eye. Anyone can deal with a hairy mole which does not come into this area. With one exception, all the cases of hairy moles of the face I have had to treat have been in children, and I have treated them all by the arm-flap method. For most plastic surgery, where a large flap is required, the tubular method, which has been developed by Gillies and Kilner, is the most potent, but I still hold that, in the case of children, the arm-flap method has advantages. In the child it is easy, by throwing the arm over the head, to get the face practically buried in the shoulder, and if you dissect off the hairy mole and turn a flap out from the chest, bring the arm up to the face and apply that flap, you may in this way replace very large areas of skin.

In many cases a difficulty arises from the development of a slight ectropion: I think it is not so much due to the direction of the scar as to injury to the orbicularis palpebrarum at that point, and possibly to its nerve supply. The mole in many cases is a black, thick structure like the material of a dog's snout. You see by this photograph of a boy afterwards that there was little disfigurement to be seen.

(A series of photographs was shown to illustrate the method.)

I have only operated upon one adult case, a very extensive mole of the face in a man, aged 21. I excised as much of the black tissue as I could, but that left him without an eyebrow on that side. I used a piece of the mole, swinging it down to form an eyebrow.

Another case was that of a carcinomatous ulcer, developing on lupus of the face. It was an old and very extensive lupus, and it had also destroyed the corner of the mouth, and the patient's teeth were showing through. The difficulty of inserting a graft without dragging down the eye and forming an ectropion was very considerable. I dissected out the ulcerated area, replacing it with a graft from the arm, and I closed the angle of the mouth.

With regard to the carrying out of the procedure, there is one point which only came home to me recently. In the first cases I operated upon I pressed the head firmly into the arm when it was raised, being under the impression that in this way I obtained a shorter pedicle. The disadvantage of that, however, is that sepsis is inevitable. If one is content with putting the arm less close to the face, it can be fixed securely, the whole operation is rendered easier, and the area can be kept absolutely clean.

Mr. A. W. Ormond, C.B.E.

It will, I think, be most serviceable for the purpose of this debate if I make a general reference to the difficulties with which we, as ophthalmic surgeons, are most frequently called upon to deal in connexion with plastic surgery of the face in the region of the eye; and further enumerate the various procedures which are available to meet those difficulties.

We may say that to repair or replace either or both eyelids; to correct irregularities of the lids following cicatricial contractions which have led to exposure of the globe, entropion, ectropion, epiphora, or deformities of the lid margins; and to make or deepen a socket for the purpose of wearing an artificial glass eye, form the major portion of our work in this connexion.

These defects may be brought about by direct injury, by destruction from acids or corrosive substances, burns, ulcerative inflammations or as the result of removing growths or malignant ulcers. The various means available to meet these difficulties consist in making flaps or grafts:—

(1) *Flaps*, consisting usually of the whole thickness of the skin, may be pedunculated or non-pedunculated. The pedicle may consist of flat skin, tubular skin, soft tissue, or a square base of skin. Flaps when non-pedunculated may be autoplastic or homoplastic, that is, either obtained from the patient's own body or from the body of some other patient or animal, and may be augmented by bone or cartilage additions.

(2) *Grafts* consisting of epithelial layers only, may be small multiple islands of epithelium placed on a granulating surface, or larger areas obtained after the method of Thiersch and applied directly on to a raw surface or stretched over a mould as in the method employed in making epithelial inlays or outlays.

In the case of pedunculated flaps the pedicle may be of skin applied with its raw surface to the underlying tissues in the same way as the main flap; it is employed to support the nutrition of the flap by connecting it with its original bed, or the skin may be raised and rolled round on itself to form a tube. This tube may be used also as a nutrient bridge, but the skin forming the flap may then be obtained from some considerable distance away from the face. This method was used with success in the war, skin being obtained from the chest or root of the neck to replace loss of skin on the face or forehead; I found it useful in a case of my own where I had a large hole to cover over and very little healthy skin in the immediate neighbourhood with which to work.

With regard to the general principles which should be adhered to in cutting these flaps when they are taken from the skin in the immediate neighbourhood of the wound, Jacobovici laid it down that: (1) The pedicle of the flap should be near to the loss of substance. (2) The long axis of the pedicle should correspond to the long axis of the flap in its new situation. (3) When cutting the flap care must be taken that it is near the pedicle or that it is a continuation of it. (4) There need be no fear that the long axis of the flap is too curved, for in virtue of the elasticity of the skin the detached flap takes the desired direction.

"Island" flaps, in which the pedicle consists of some soft tissues, muscles, &c., with a small arteriole embedded in it, have been advocated by Esser, of Arnheim. There is no skin pedicle, but one, of the deep soft tissue, which is taken from as near

the defect as possible, and is so placed that a branch of an artery is in the pedicle. When a bridge of skin remains between the defect and the flap, this is divided, and some tissue removed to form a bed for the pedicle. The flap may be half the size of the defect, since the latter is decreased in size in sewing in the flap. The advantages of the "island" flap are striking in nourishment and cosmetic effect, as no turned skin pedicle is subsequently to be seen, and the tension is equal everywhere.

Dieffenbach's and Burow's methods of repairing the lids by the shifting of healthy skin in the neighbourhood of the injury, have been described in most text-books which deal with these difficulties. Grimsdale and Brewerton have described them very clearly in their "Ophthalmic Operations." I will not discuss these in detail, but only say that their use is limited, and that they sometimes fail as the contraction may be considerable.

With regard to non-pedunculated skin flaps, these may be obtained from a distance and placed in areas prepared for them; under favourable conditions they achieve their object, but homoplastic grafts are very rarely, if ever, successful if they involve the skin, whereas autoplastic grafts, that is to say, those obtained from the patients' own tissues, may be, and often are, quite successful. The bed on which the graft is to lie should be moist but free from oozing blood, and the graft should fit accurately into its bed. Movement of all kinds should be avoided or reduced to a minimum, and firm bandaging and non-interference secured for at least several days.

It is a matter of dispute as to what size the flaps should be, compared with the wound to be covered in. I find one must vary the size; if the whole flap lives and joins up rapidly, the contraction is not great,—on the contrary, very little, but sometimes the edges of the flap suffer, and then the contraction appears to be considerable. A flap fitting a raw surface with a subjacent bone or cartilage basis will not contract as much as if the bed consists entirely of soft tissue.

The methods of dealing with a contracted socket still remain unsatisfactory, and the most difficult of all the various requests made to one during the war was to obtain for the patient a socket in which an artificial glass eye could be worn that would look tolerably presentable. It must be confessed that success did not always attend the greatest efforts in this respect, and repeated operations on the part of the surgeon, and considerable patience on the part of the patient, were often unavailing; the reason being that the substitution of the destroyed conjunctiva is extremely difficult. Mucous membrane grafts from the mouth or from the foreskin are difficult to render aseptic, and contract to such a degree that they ultimately achieve little.

Epithelial inlays also are, in my experience, disappointing when used to enlarge a contracted socket, although my surgical colleagues are more enthusiastic over the results of an inlay when used in the mouth or elsewhere. I think that probably we begin too superficially in these cases, and that our first efforts should be to obtain a substitute for the globe by inserting a cartilage, paraffin, or filigree ball; the contraction of the epithelial inlay is greater when there is nothing to stretch the grafts, and since the grafts are placed on soft tissue without a firm point of attachment at all, contraction is unimpeded. The implantation of an artificial globe may be carried out in the way described by Webster Fox, in the *Ophthalmoscope*, 1909, vii, p. 10, and if the globe is present, a thin convex or curved Stent covered with a Thiersch graft has more chance of remaining stretched, and of lining a cavity which would remain of a reasonable size. During the war I used cartilage as a substitute for a glass globe, but I think paraffin balls are the most useful of all.

The technique of Thiersch grafting is important. In cutting Thiersch's grafts I find that a large flat knife, with a blade 1 in. or more deep, enables one to obtain the largest grafts; the knife and skin are kept moist with sterilized normal saline irrigations, by means of an undine. The skin to be used may be taken from the volar surface of the forearm or the inner side of the thigh, the skin should be kept taut by an assistant and the knife moved with a sawing movement and kept as horizontal as

possible. The graft then rides up over the knife and the broad blade of the knife acts as a carrier of the graft to the wound where you wish to apply it; it is removed from the blade by a needle in a handle, aided by a stream of saline solution. With regard to the wound to be grafted, all granulations should be completely removed with a curette, or better with scissors; perfect hæmostasis should be obtained by pressure, the grafts should be cut as thin and as large as possible and when they are transferred to the prepared surface there should be the minimum of manipulation. The wound may be washed, when necessary, with sterilized normal saline and kept immobile; covered with thin, dry gauze dressing and cotton wool and left untouched for one week. Then the dressing should be removed by soaking for as long a time as is necessary to float off the wool and the gauze, and this may require as much as half an hour or even an hour.

In considering which of these various methods are applicable in the particular case which we have under consideration, various points must be thought of, such as the size of the wound, the condition of the skin around, the applicability of grafts, &c., and obviously one method or another may have to be ruled out at once. I would, however, urge that a very important factor is the length of time which must be involved in carrying out either one method or another. We must also judge carefully of the number of operations which it may be necessary to perform in order to achieve our end. During the war we were in some degree limited in this respect owing to the necessity of passing our patients on in order to make room for others; but after the war there was not this same hurry, neither was time an important factor when the patient was so severely damaged as to necessitate his remaining in some special hospital during a long period for expert treatment.

When, however, we come to decide our procedure in civilian cases in peace time, we should, I think, pay some regard to the individuality of our patient, I mean his position in life, his usual occupation, and also his financial standpoint, as I find not infrequently that the necessity of a long stay in hospital, repeated operations, involving the giving of an anæsthetic, and the psychological effect of continued inactivity and absence of earning power, sometimes produce an unsatisfactory effect on the patient's general mental outlook. So, too, I would urge that we do not look on these cases only as opportunities for the exercise of our surgical skill, but consider the case primarily from the point of view of the patient whose general health is of the utmost importance, and let that consideration influence us in the choice of the method we decide to employ. When, however, there are no circumstances such as I have indicated to limit our decision, the method giving a result most nearly approaching the normal should be employed.

Mr. T. Pomfret Kilner.

It is not my intention to demonstrate to you any of the more extensive reparative operations about the cheek and eye, but to confine myself entirely to a description of three procedures which Mr. Gillies and I have found to be particularly useful in the plastic surgery of the difficult region under discussion this evening.

The first, and most commonly called for of the three, and one which is in almost everyday use, is that which has been named the "epithelial outlay,"—a modification of the pressure-dressing method of skin-grafting introduced by Esser for eyesocket conditions in 1917, and later modified and extended in its field of usefulness by Gillies and his colleagues in their work at Sidcup.

The cases most commonly calling for its use are those of burns in this region, but it may be used with advantage in every case of cicatricial ectropion from whatever cause. The results obtained are uniformly good.

An incision is made from canthus to canthus just outside the ciliary margin of the affected eyelid. The ciliary margin of this incision is picked up by a fine hook,

and the incision is steadily deepened until all scar-tissue bands have been divided, and the lid is capable of being brought into an over-corrected position. Search is made for any further cases of scar tissue in the raw surface thus exposed, and this is carefully removed until the muscle of the eyelid is clearly exposed. A mould is now made in Stent of this raw surface. This mould may be made bean-shaped, the eyelid being turned into the ectropic position again over it during the setting process, or it may be made to fit in a flat manner on the surface, and be provided with an extension piece lying to the outer side of the eye. A Thiersch graft from a non-hairy part of the body is cut and wrapped around the mould with its raw surface outwards. The mould, covered by graft, is now applied to the raw surface. In the first method the mould is held in position by a few sutures, which pass from one edge of the incision, through the edge of the graft on that side, across the front of the mould, through the edge of the graft on the opposite side, and lastly, pick up the other edge of the incision. These sutures are tied loosely, and partly bury the mould in the now ectropic eyelid. In the second method the mould, covered by its graft, is fixed by strapping over the extension piece projecting from its outer side. The addition of a further pad and bandage makes sure that even pressure is applied to the graft. The mould is removed in from five to seven days, and the grafted area is dressed with a greasy preparation and gently massaged for a further few days. Minor trimming of the edges of the graft may be required at a later period.

Two things may lead to failure: (1) attempts to apply the method when both lining and covering of the lid are missing. Nothing short of a more extensive plastic operation is of any use in such cases. (2) Incomplete removal of scar tissue. Further contraction, followed by puckering of the graft, occurs in such cases. Such a failure is to be expected when the method is used as a prophylactic measure in recent burns, and in those cases in which the scar tissue is so extensive and deep that it cannot possibly be removed without destroying the muscle fibres of the orbicularis. Even these cases will give satisfactory results if the operation is repeated later, when all contraction is at an end.

(Several slides of case records in which the method had been employed were shown.)

The second procedure is that undertaken for the provision of new eyebrows. It is not generally realized what important functions the eyebrows serve, and it is only a considerable experience of severe burn cases which has led us to recognize how well worth while it is to remake them. We have come to know, by observation of many cases, that they possess three perfectly definite functions: (1) Shade from the sun. (2) Sweat collection; in their absence sweat continually runs down into the eyes during exercise. (3) Protection from wind, a function only realized by patients whose eyelids are ectropic.

Eyebrows may be made by whole-thickness hair-bearing grafts of the Wolfe variety taken from the scalp, or by flaps based on the superficial temporal artery. In either case it is essential that the area should be carefully inspected beforehand, in order that a choice may be made of skin in which the hairs are growing in the right direction. Both types of graft are sutured into beds prepared for them by incisions along the eyebrow line; the Wolfe graft is pressure-dressed by means of a Stent mould applied over a sheet of thin silver foil. It is interesting to speculate in connexion with these grafts whether an area of skin which would normally become bald on the scalp will retain its hair-bearing properties in the eyebrow region.

(Slides illustrating both methods were shown.)

The third procedure, of which I wish to give a brief outline, has been employed in only two cases in which I have assisted Mr. Gillies, and it is, so far as I know, an entirely new one. It consists in the use of a Thiersch graft in the treatment of symblepharon.

In the first case the lower lid was completely adherent to the front of the globe. The condition was produced by an acid burn and caused much pain and discomfort. The eyelid was carefully dissected off the globe and a lower conjunctival sulcus of good depth was made. A mould in gutta-percha carrying a Thiersch graft was fitted into this new sulcus and maintained in position by a splint carried from caps on the teeth. The outer surface of the sulcus was successfully epithelialized in this way, but the globe surface did not do quite so well because of the constant movement of the globe on the fixed splint. The final result, however, was very gratifying. In the second case both lids were adherent. After freeing of the lids from the globe, a shell-like mould was made to fit in front of the globe and upwards and downwards into the two newly-made sulci. The eyelids were sutured together over it.

In the former of these two cases the globe skin graft was tattooed by Colonel Kirkpatrick, and gave a very satisfactory result. For the second case a thin shell eye was obtained to fit over the globe. This moved with the eye, and, apart from giving a slightly proptosed appearance, it could scarcely be distinguished from a normal eye.

Mr. KILNER showed a case of Complete Evisceration of the Orbit treated by Skin-grafting on a mould.

Mr. G. H. POOLEY.

My experience of these plastic operations consists of about twenty operations a year in ordinary times. During the late war I did a good many more, as I was in charge of the centre for artificial eyes for the Northern Command, with 110 beds, and so had a good many plastic operations to carry out.

The conditions for which plastic operations are usually required are those in which there is extensive loss of skin, with or without loss of soft parts and perhaps loss of bone as well.

(*a*) The surgical removal of tumours, &c.; these are all fairly free from sepsis.
(*b*) Fairly clean accidental wounds.
(*c*) Burns, by molten or hot metals, also chemical and electrical, followed by contraction.
(*d*) Septic conditions with extensive sloughing.

In the case of the first group, (*a*), plastic operations can be performed immediately if the base is satisfactory and the condition of the patient warrants it, or as soon after as possible before any shrinking occurs.

In that of the second, (*b*), operations can be performed as soon as the wound is clean and quiet.

In the case of the third, (*c*), plastic operations must not be carried out until contraction of the scar has become nearly stationary.

In that of the fourth, (*d*), no operation must be done for at least twelve months after the sepsis has apparently ceased and all is quiet, otherwise the sepsis is likely to light up again.

When operating on any but recent injuries it is best to incise the skin about one quarter of an inch from the palpebral opening parallel to the margin of the eyelid or eyelids affected, for often the upper and the lower lid are retracted; to divide all cicatricial bands, and to retract the cut surfaces as far as you possibly can before putting your fresh flap in position.

I find a large flap on a wide pedicle the most satisfactory. It should be large enough to fill the cavity to overflowing, so that it is rather compressed in the space instead of being stretched across it. I take as much subcutaneous tissue as I can and cut straight down through the skin and subcutaneous tissue to form a flap, so that there shall be no hollow beneath the skin where the flap joins the cut tissue. I like the subcutaneous tissue to fit tightly and fully into the space prepared for it. Usually, in repairing the eyelids, I suture the two lids together, without cutting them, so as to keep the eyelids closed and motionless during healing.

A large flap taken from the temporal and frontal region, i.e., from the forehead at its junction with the scalp, and long enough to reach easily across to the nose, is most satisfactory. If both lids need repair, a wide flap can be taken and its extremity split to make a fork, the upper limb of which forms the new upper lid, and the lower limb the lower lid. If this flap contains a main branch of the temporal artery, or the artery itself, its blood-supply is secure. I do not make a caterpillar flap, but cut the skin so that the flap can be sutured in all its length. When the flap is secure in its new home, with its new blood-supply, some six months after the operation, I divide the part of the pedicle which is not wanted, restore it to its original place, and bring the original skin edges into apposition again.

This operation is very useful in the case of extensive burns, lupus and X-ray deformities, &c. For the upper lid alone a strip of skin can be taken from the forehead: its width is from the inner end of one eyebrow to the inner end of the other eyebrow. In length it reaches as far as the roots of the hair of the scalp; this makes an excellent upper eyelid. The gap in the forehead can easily be closed.

For this work I like a suture which goes right through the thickness of the flap parallel to its cut edge and comes up through the whole thickness of the subcutaneous tissue and the skin to which it has been sutured. I use ophthalmic fishing gut for the purpose and interpose an alternate layer of superficial skin sutures. All blood-vessels of any size should be tied with catgut, but I do not find that a little oozing does any harm. I apply dry dressing. If the vitality of the flap looks at all doubtful I use hot boric fomentations to keep it warm—these might be made with normal saline for the first few days. I do not use iodine to sterilize the skin (it is too irritating to the conjunctiva), but a mixture of methyl violet and brilliant green in dilute alcoholic solution. The formula is methyl violet ½ per cent., brilliant green ½ per cent., sp. vini rect. 35 per cent., aq. dest. 64 per cent., and this gives quite satisfactory results.

A modified, long, temporal skin flap can be used in cases of badly contracted socket, the conjunctiva is cut through from the inner to the outer canthus and the cut continued through the skin outwards from the margin of the orbit, while a transverse incision at the margin of the orbit gives room for the insertion of the flap without cutting through the outer canthus; the conjunctiva is dissected up above and down below and forms the palpebral conjunctiva; the base of the socket consists of the skin from the flap. I intend to try caterpillar flaps, as described by Gillies, when I have a suitable case.

Patients cannot tolerate the long continued binding of arm to head if the skin from the arm is taken. Skin, taken from elsewhere and grafted in, often lives, but in my experience it shrinks in the course of a few years and is not really satisfactory. The same thing applies to skin rolled on dental wax; the average late results are not satisfactory, the skin is of a dead white, not a proper colour. Sometimes the lesion is a relatively small one; for example, there is the case of a patient in whom the skin of both eyelids has sloughed after a mixed injection of anthrax and streptococci. The loss of skin, however, does not go beyond the margin of the orbit below, although nearly the whole of the skin of the upper lid has disappeared; the orbicularis palpebrarum is left intact and the skin round is quite healthy. Here four pedicle flaps, two for each lid, give an excellent result.

If there is one complication of a big burn which causes more trouble than almost any other to the surgeon, it is an extensive adhesion of the eyelid to the eye, particularly when a large part of the cornea is involved. All the methods I tried at first, such as division of the adhesions and the covering of the raw surface with mucous membrane, failed, though they often gave satisfactory immediate results and restored the movement of the eye. Yet in the course of a year or so the tissues contract and the lid becomes adherent to the eye again, the end result being little better than the original.

A few years ago I tried another method. I divided a gross adhesion of the lower lid to the lower two-thirds of the cornea, and cut through the tissue which obliterated the lower fornix of the conjunctiva, cutting freely to each side and continuing my incision below until I was some three-quarters of an inch below the original fornix. I then sutured a layer of rubber sheeting into the wound so that it kept the two raw edges apart. I left it *in situ* for months until epithelium had grown over the raw surfaces, and the result, which I showed at a meeting of the North of England Ophthalmological Society, was most satisfactory; other cases have done well, too, and I recommend others to try the method.

Mr. J. J. M. Shaw (Edinburgh)

showed a series of lantern slides to illustrate various methods of plastic repair in the region of the eye.

In the first case, loss of the lower eyelid and region of the inner canthus had been restored by a portion of a forehead pedicle-flap which was being utilized for the complete

Thiersch graft for ectropion of left upper lid, twenty-two months after operation. Case of old-standing lupus in which exposure had already caused loss of one eye.

rhinoplasty which the patient also required. This case was operated upon at Sidcup Hospital, the deformity being due to a gunshot wound.

The second case was of similar origin, being that of an Italian lady who had been struck in the cheek by a bullet in a dance hall in Rome. The greater part of the floor of the orbit

on the right side had been shot away, allowing sagging of the eyeball. Repair was effected by a subcutaneous implantation of a shaped portion of costal cartilage.

The treatment of cicatricial ectropion by means of a Thiersch graft outlay upon a mould was described and illustrated in cases of burning.

The same method had also been employed in a severe case of lupus in which one eye had already been lost by the unnatural degree of exposure due to ectropion and consequent ulceration and eventual disintegration. When first seen, the remaining eye showed a moderately progressive degree of corneal ulceration. A Thiersch graft was applied for the correction of the ectropion of the upper lid, the graft being inserted into an obviously diseased area. The ulceration cleared up within a week of this restoration of the protective and cleansing action of the lid. Twenty-two months after this operation there was no sign of infection or shrinkage of the graft and no trace of ulceration of the cornea.

The fortunate issue of this graft was an additional demonstration of the absence of spread in lupus by simple contiguity, and, as Handley had demonstrated, the lymphatic paths of infection in such a chronic case would be sclerosed and broken up except at the spreading margin, which was, by the time of operation, far removed from the region of the eye.

In the operative treatment of large hæmangiomata of the face, the forehead pedicle flap was employed, but, when the lids were involved, emphasis was laid on the undesirability of including them in the area of excision.

A case was illustrated in which adequate blanching of the lower lid was effected by searing it with an electro-cautery on the two occasions on which a forehead-flap substitution for the adjacent hæmangioma of the cheek was being carried out as a two-stage operation.

Mr. M. W. B. Oliver

showed a number of diagrams and photographs illustrating the methods of reconstruction of the eyelids (see pp. 29-38).

He said he adopted a similar method to that described by the last speaker, and he laid stress on the importance of not making the grafted lids bulky. A temporal flap should always include the superficial temporal artery.

He agreed with Mr. Pooley's statement that the results in contracted sockets from epithelial inlays were very bad, but he thought it was the fault of the operator. In order to carry out a proper epithelial inlay it was essential to remove the whole conjunctiva and all the orbital tissue. He removed everything down to the periosteum. It was necessary to have a very large mould to fill the whole cavity, and the anterior surface of the mould should be convex, so that, when sutured, the lids would be tightly stretched over it. In order to secure a good result, the mould must be covered with one single skin graft, for if there were gaps the case would be a failure.

Mr. Arthur Edmunds

said that the cases of which he had most experience were those cases of rodent ulcer in the neighbourhood of the orbit. Removal of them was usually a comparatively simple matter, but restoration of the parts afterwards was by no means as easy.

He believed that the use of sliding flaps was the best method whenever it was feasible. In many cases, of course, it was not possible, and preceding speakers had shown how, in these cases, other methods could be employed with the most satisfactory results.

After the removal of rodent ulcer, it was, however, generally possible to use sliding flaps and to perform the whole operation at one sitting, leaving a completely sutured

wound. The description of these operations was difficult, but he employed three main flaps, shown in the illustration (fig. 1).

(*a*) A forehead flap involving the tissues down to the occipito-frontalis, which must be carefully protected from injury. When this flap was used, a gap was usually left in the hairy scalp, which was skin grafted later. If the occipito-frontalis tendon were not left, this wound took an exceedingly long time to granulate.

(*b*) The cheek flap. This followed the line for excision of the upper jaw, except that, in place of extending into the lip it ran along the naso-labial fold. This flap could be dissected up freely and brought up towards the root of the nose to fill up deficiencies along its margins.

(*c*) The nose flap. When the cheek flap could not be brought up into the inner angle of the eye, the skin of the nose could be dissected up leaving a pedicle above or below. This could be turned in to meet the cheek flap on the affected side, leaving a gap which could be closed by a second cheek flap on the sound side.

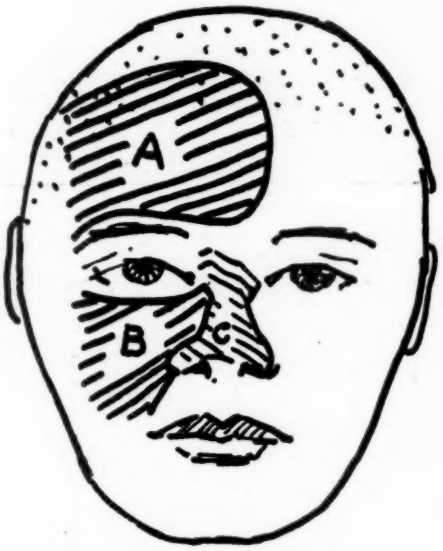


FIG. 1.

It was possible to use these three flaps as a basis for a very large number of plastic operations around the eye.

If the globe was involved, it was often better to excise it—to close the orbit with sound skin, the patient wearing either an eye shade or a silver mould painted in low tones. This gave the effect of an eye in shadow ; and the junction of painted metal with the skin was very well concealed by wide-rimmed tortoise-shell spectacles.

Case I.—Showed the use of the forehead flap to restore a deficiency left by removal of the eye and surrounding bone (figs. 2*a*, 2*b*).

Case II.—Restoration of the inner canthus by a cheek flap (figs. 3*a*, 3*b*).

Case III.—Showed the use of the nasal flap (figs. 4*a*, 4*b*).

Case IV.—Closure of the socket with replacement by a silver mould kept in place by wide-rimmed spectacles, which also concealed the line of junction (figs. 5*a*, 5*b*, 5*c*).

FIG. 2 (*b*).

FIG. 2 (*a*).

Case I.—A patient with fungating ulceration—rodent ulcer—involving the side of the head. The deficiency was repaired with a forehead flap.

FIG. 3 (*a*)

FIG. 3 (*b*)

Case II.—Rodent ulcer of the inner canthus restored by a cheek flap. There was extensive removal of the bone and a large opening was made into the nose. The inner third of the lids was excised. A tube was passed into the nose and brought out through the external nares, being fastened to itself in the form of a ring, which lay on the cheek. The skin was sutured over the tube which was left in place for ten days. The outer canthus is still not entirely satisfactory, but there is no epiphora.

FIG. 4 (*b*)

FIG. 4 (*a*)

Case III.—Rodent ulcer of the whole thickness of the nose restored by nose and cheek flaps, the mucous membrane lining being obtained from the inferior turbinal. Additional help was obtained by a partial resection of the nasal cartilages.

FIG. 5 (*a*)

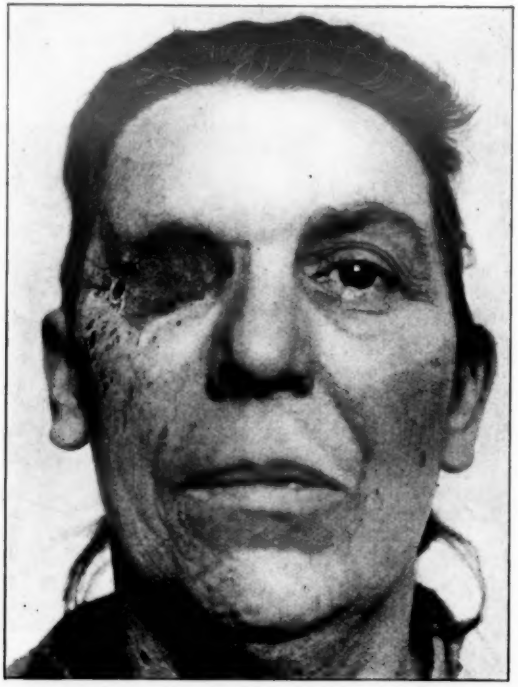


FIG. 5 (*b*)

Case IV.—A patient who had a rodent ulcer involving the conjunctiva. Part of the malar bone was removed and the orbit closed by sliding flaps and the upper lid.

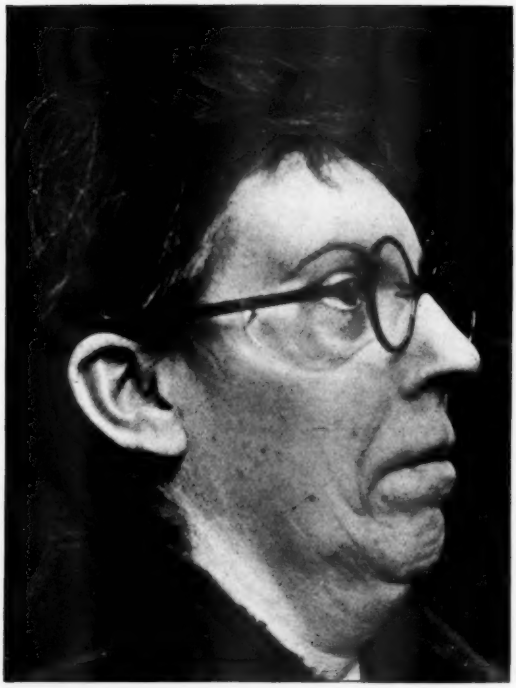


FIG. 5 (*c*)

Case IV.—A patient who had a rodent ulcer involving the conjunctiva. Part of the malar bone was removed and the orbit closed by sliding flaps and the upper lid.

DIAGRAMS AND PHOTOGRAPHS SHOWN BY THE LATE MR. M. W. B. OLIVER, M.B., F.R.C.S.[1]

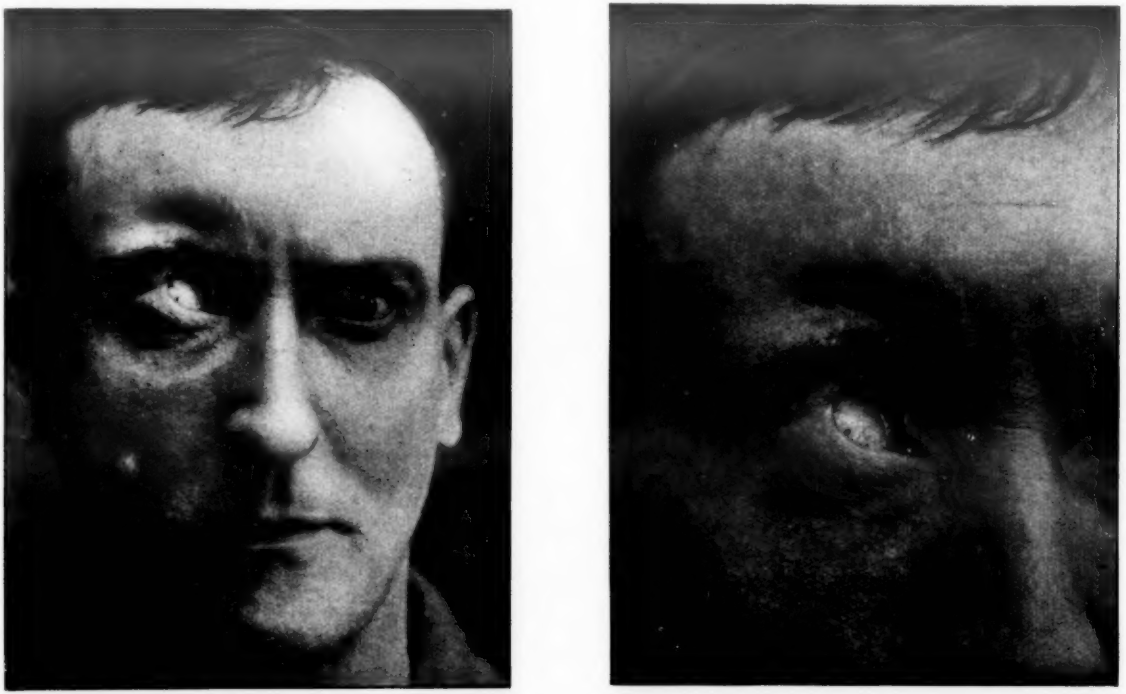
Private D., C. D.—Method of reconstructing upper eyelid by tubed temporal flap. (Mucous membrane intact.)

(1) Flap outlined.
(2) Skin scar excised and normal position of lid margin obtained. Temporal flap raised and pedicle tubed.
(3) Flap sutured in position: raw surface on temporal region closed by approximation.

[1] These illustrations have been kindly arranged and supplied with legends by Mr. T. Pomfret Kilner, F.R.C.S.

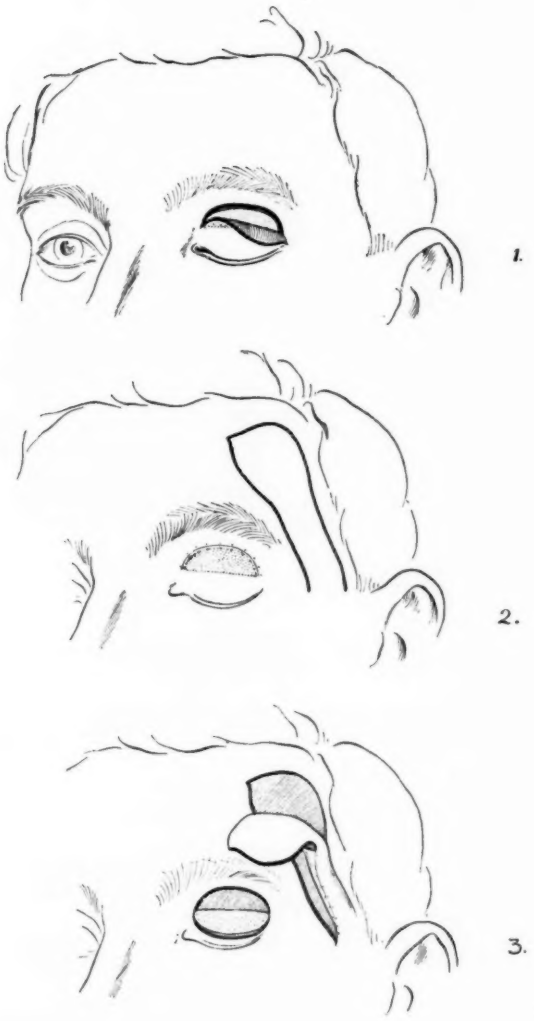
Private D., C.D.—Method of reconstructing upper eyelid by tubed temporal flap. (Mucous membrane intact.)

(4) Pedicle divided.
(5) Redundant pedicle removed.
(6) Operation completed. A small cyst has been excised from the cheek.



Method of reconstructing upper eyelid by tubed temporal flap (mucous membrane intact).
(1) Original condition. (2) Original condition.

Method of reconstructing upper eyelid by tubed temporal flap (mucous membrane intact)
(3) Tubed temporal flap in position. (4) Final result.

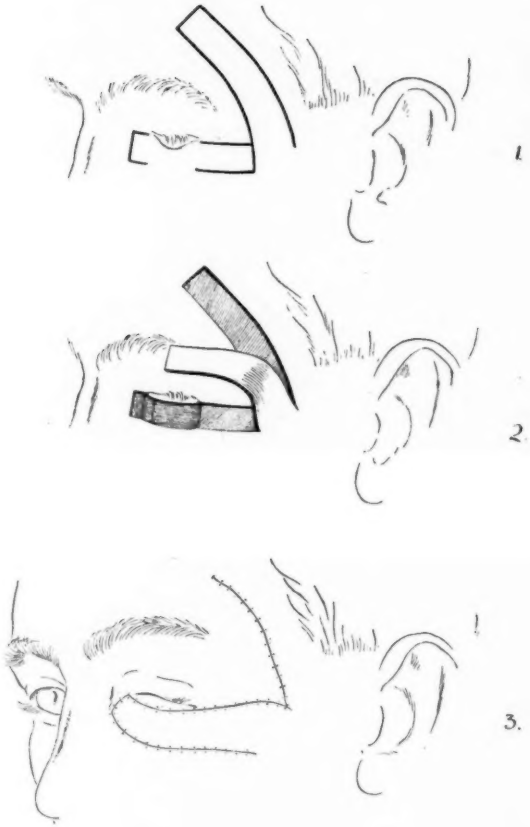


Rifleman T. F.—Method of reconstructing upper eyelid. (Complete loss.)

(1) Skin flap raised in region where new eyelid is to be made. Thin cartilage graft inserted.
(2) Flap sutured back over graft. Temporal flap outlined but not raised.
(3) Eyelid flap raised and turned down to make lining of new lid. The cartilage graft is now adherent to its deep now outer surface. Temporal flap raised and pedicle tubed.

Rifleman T F.—Method of reconstructing upper eyelid. (Complete loss.)

(4) Raw surface of new eyelid covered by temporal flap.
(5) Pedicle returned to temporal region.
(6) Operation completed. Raw surface in temporal region closed by approximation.



Rifleman T. F.—Method of reconstructing lower eyelid. (Complete loss.)

(1) Flaps outlined.
(2) Small local flaps turned in and sutured together to form lining of new lid. A suture line should be shown along the lower border of these where the new lower fornix is closed below.
(3) Temporal flap covering in all raw surface. Defect in temporal region closed by approximation.

Y.—(1) Loss of lower eyelid.

X—Reconstruction of upper eyelid (mucous membrane intact) by temporal flap.

(1) Later stage of the same case.

(2) Eyelid restored partly by local rearrangement flaps and partly by flap from upper eyelid.

(5) Artificial eye well supported by new eyelid.

(4) Later stage of the same case.

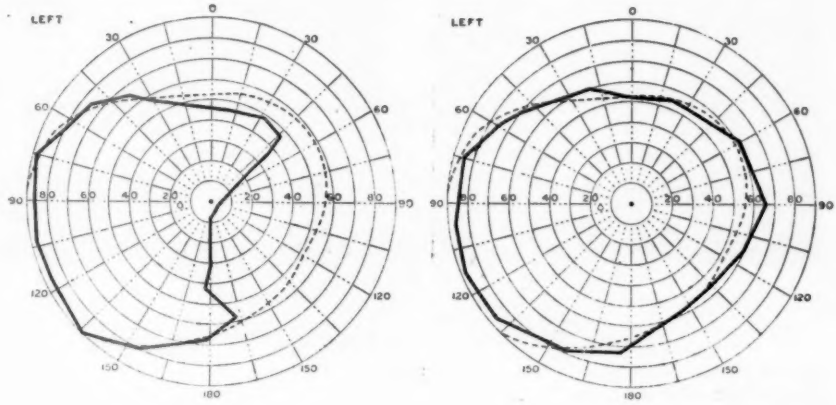
Section of Ophthalmology.

President—Sir ARNOLD LAWSON, K.B.E., F.R.C.S.

Case of Re-attachment of Retina, after Spontaneous Detachment and Operation.

By A. F. MACCALLAN, F.R.C.S.

THE patient, aged 28, was first seen on May 18, 1925. She said that she had been unable to see with the right half of her left eye for about a fortnight. She had had no injury. Right vision with sph. – 6D. $\frac{6}{6}$. Left vision with sph. – 8D. $\frac{6}{18}$. A recent detachment was seen in the outer and upper part of the fundus of the left eye, which corresponded to a deficiency in the visual field, as shown by McHardy's perimeter (Chart No. 1).



She was admitted to the Royal Eye Hospital on May 20, 1925. On May 26 a scleral puncture was made in the upper and outer quadrant of the sclerotic with a Graefe knife, which was passed into the globe and moved through a segment of a circle, the scleral wound being opened as little as possible. This was with the intention of effecting a rent in the retina. No fluid was observed to escape from the puncture externally.

She was kept in bed for three weeks, and at the end of that time no detachment was visible and her field was normal (Chart No. 2, dated July 23); and the vision with correction was $\frac{6}{18}$. On February 6, 1926, the field was normal (Chart No. 3). With Bjerrum's screen at a distance of 2 metres (Chart No. 4) there are several small scotomata, in addition to the blind spot, one of which probably corresponds with the operation scar in the retina, which is visible ophthalmoscopically. Left vision with sph. – 7D. $\frac{6}{12}$.

Case of Congenital Ptosis: Young's Operation.

By A. F. MacCallan, F.R.C.S.

PATIENT, a boy, aged 4, was first seen in October, 1925. There was ptosis of the right upper eyelid which had been present since birth. When the frontalis was not being used the pupil was covered.

In November I performed the operation described by Young in the *British Journal of Ophthalmology* for June, 1924. The principle of the operation is the effecting of adhesions between the upper border of the tarsus and the belly of the superior rectus muscle. A greater effect could have been produced in the present case if Young's

FIG. 1.

FIG. 2.

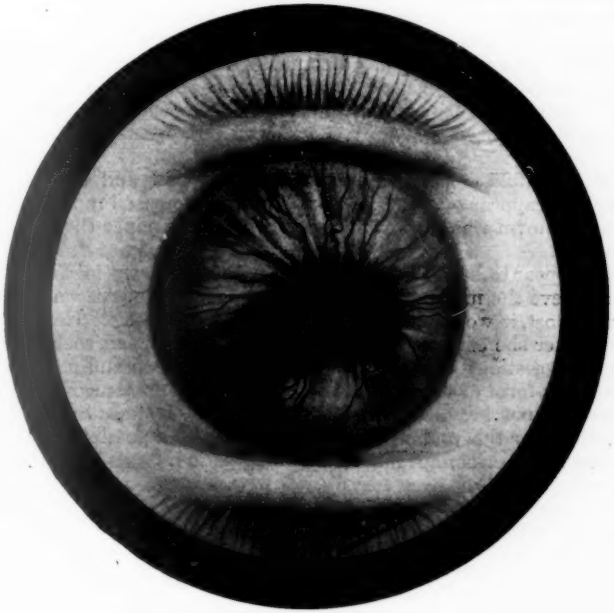
directions had been adhered to. The patient, being a child, was given a general anæsthetic; with an older patient there is no reason why the operation should not be done under novocain by subcutaneous and retro-ocular injection, with some cocain drops for the conjunctiva. The operation appeared to me to be a simple one, and was completed within fifteen minutes.

Mr. GEORGE YOUNG (Colchester) said he first performed this operation, in the case of a young girl, in 1924. It was published in June of that year. An account of the sequel of the case already published will shortly appear. The patient and her friends were desperate about the disfigurement, and he thought out the operation in order to relieve her. He had since carried it out in many cases of double ptosis, also in a case of paralytic ptosis, and he had found it very successful in all of them. Occasionally he had found a slight sagging of the outer part of the eyelid. In that instance he everted the eyelid and formed a symblepharon between the palpebral and the bulbar conjunctiva, or, for a stronger effect, he made a stronger attachment between the tarsus and the sclerotic. There had been diplopia in extreme excursions, but it soon passed off. In the paralytic case there was diplopia, but it could be corrected with prisms.

Vessels of New Formation on the Anterior Surface of Iris Emerging from the Pupil and Branching Outwards.

By RAYNER BATTEN, M.D.

MRS. F. J. N., aged 54. Vision: Right, no P. L. Left eye excised. Right eye: The pupil is eccentric and fixed with total posterior synechia to exudative membrane not to the lens, which is dislocated. Iris bombé. Numerous large, bright coloured vessels of new formation emerge from the pupil and branch outwards, lying on the anterior surface of the iris. Most of the vessels terminate at the periphery of the iris. One or two appear to extend outside and reappear on the conjunctiva.



This case, interesting as it is in itself, has a strange and tragic history. She is now a woman of 54. Her eye troubles began at the age of 9, or probably earlier, for I suspect she was a congenital myope; but at the age of 11 she attended St. Bartholomew's Hospital and was an in-patient there for three months. When she was aged 13, she attended Moorfields and had three operations on the left eye for dislocated lens but the result was a failure, and at some later date the left eye was excised.

In 1900 she came to me with detachment of the retina in the right eye, which was highly myopic. She was admitted to hospital and underwent general treatment, but without success, and she became totally blind. For seven years she was led about, acting as a tea agent. Then after seven years of total blindness she reappeared at hospital and said she could see a glimmer of light and besought me to treat her. I did so, and put her on iodides and mercury, and she gradually recovered vision. My old notes are unfortunately lost but my remembrance is that she regained $\frac{6}{18}$ with

her myopic correction. Anyway, she recovered sufficient sight to get married, and she married a totally blind man, led him about and read to him and reared a family. For a time I earned an unenviable reputation as a healer of the blind, and had many totally blind friends and acquaintances of the patient brought to me. My reputation, however, gradually faded.

In December, 1909, she struck her eye against a corner of a cupboard. The eye was injected. The iris was tremulous and the lens partially dislocated to the nasal side.

In January, 1923, the sight suddenly failed: she was unable to see with her glasses and a blue-grey blot appeared to her on the temporal side. I found that her lens had become totally dislocated into the vitreous. There was extensive choroid retinitis. The tension was raised. Her unaided vision was $\frac{6}{60}$ with $+2 = \frac{6}{36}$. It somewhat improved, and in March of that year right vision $= \frac{6}{24}$ partly.

April, 1925.—She was still seeing $\frac{6}{24}$ with right eye, but she had neglected her left artificial eye and there was a copious purulent discharge from the socket. The right eye was injected; there was conjunctivitis and ? some iritis.

From that time the right eye began to deteriorate and the sight to fail.

July 25.—Right eye $= \frac{6}{60}$, $\frac{6}{36}$ −, but her vision appeared less, to judge by her movements.

September 17, 1925.—Some circumcorneal infection and the vessels of new formation began to appear on her iris. These vessels increased rapidly week by week, and the drawing shown was made at the end of October; since then there have been further changes.

This would appear to be the last stage in this "strange eventful history." I offered to operate to relieve the iris bombé, but she declined, for the reason that, if it failed and the eye was lost, it would damage her personal appearance. Her present anxiety is to know whether she can resume the artificial eye in her left socket.

I have no suggestions to make as regards the causation and pathology. I have been told that this form of vessel formation is indicative of glaucoma. It may be so, but glaucoma has not been a marked symptom. Mr. Holmes Spicer, in the report of his case, suggests the prolonged use of eserine[1] as a possible cause in his case. My patient has had eserine, but not for any long period.

Ocular Torticollis.

By P. G. Doyne, F.R.C.S.

Ocular torticollis is not a very uncommon condition in children, if looked for, though it is in only an occasional case that the deformity is so marked as to be conspicuous. It is nearly always of congenital origin. It has to be distinguished from true torticollis. In ocular torticollis the position of the head is chiefly one of tilting to one side or other; there is little if any rotation of the chin to the opposite side, in fact the chin is often pointed to the same side. The head can be easily straightened and no tightening of the sternomastoid is noticed when this is done.

Hemiatrophy of the face is said to be usually not very marked in ocular torticollis, though in the case reported by Cockayne, and in all my cases, there was very obvious facial asymmetry.

Diplopia is not complained of when the head is in the assumed position, but is said to appear when the head is straightened. Binocular vision was present in Cockayne's case.

[1] "Vessels of New Formation on the Anterior Surface of the Iris after prolonged use of Eserine," *Trans. Ophth. Soc. U.K.*, 1902, xxii, p. 306.

Ocular torticollis appears to be a posture adopted to compensate for weakness of one of the muscles controlling the movements of the eyes in the vertical plane. The head is tilted to the side of the most dependent eye. If the right eye is lower than the left eye, the head will be tilted to the right. This seems to hold good in all cases. According to Abelsdorff, the name "ocular torticollis" should be applied only to those cases produced by paralysis of the superior oblique. His statement is that the superior oblique and superior rectus act in conjunction in rolling the eye inwards, but in opposition as regards movements in the vertical plane. When the superior oblique is out of action, inward rolling of the eye is performed by the superior rectus, but the associated elevation of the eye by the superior rectus is now not opposed by the superior oblique, and consequently the eye squints upwards. If the head is tilted away from the side of the paralysed superior oblique, then the paralysed superior oblique is not called upon to act. This posture—the head tilted away from the side of the paralysed superior oblique—will be adopted. Abelsdorff states that the torticollis always corresponds to the side of the healthy eye. This is, I think, always true, but it would appear that ocular torticollis can certainly be caused by weakness of other muscles than the superior oblique. Pierola describes a case in which the torticollis seemed to be definitely due to a weakness of the left inferior rectus; and Duane, in his textbook, gives illustrations of a case due to congenital paralysis of the superior rectus, with spasm of the inferior oblique. High degrees of oblique astigmatism are said to cause a tilting of the head.

I have one case, that of a boy, aged 9, who tilted his head slightly to the right. He had 3 D. of hypermetropia and 3 D. of astigmatism, the axis of which was slightly down and to the right in both eyes. I cannot say that correction appeared to make any difference to his tilt, but the case was complicated by his having a right internal strabismus with slight amblyopia in the right eye—vision with correction in this eye being $\frac{6}{18}$. There appeared to be no limitation of movement in either eye and no heterophoria was demonstrable with the Maddox rod.

With regard to my cases of ocular torticollis—all of which I have seen at the Hospital for Sick Children, Great Ormond Street—they are five in number, but in only two of them was the condition grossly obvious. These two, in fact, were transferred from the Surgical Out-patients Department to the Eye Department.

Case I.—V. W., a girl, aged 7; rather backward; was transferred by Mr. Fairbank to the Ophthalmological Department. The tilting of the head had been noticed since birth. She tilted her head to the right with a very slight inclination of the head to the right. Upon holding the head straight, which could be done quite easily, the left eye was slightly elevated as compared to the right eye. On turning the eyes to the right, this elevation of the left eye became more marked, but on turning the eyes to the left they became parallel.

With the Maddox rod, the head being held straight, a right hypophoria was demonstrable. There was definite hemiatrophy of the right side of the face; refraction showed 2 D. of hypermetropia. This correction was given her, but made no difference to the head tilting. In consequence, after a few months' observation, I tenotomized the left inferior oblique. The result of this operation was a marked improvement in the position of the head, only a very slight tilt being noticeable.

Case II.—D. F., a girl, aged 6. She was transferred to the Ophthalmological Department from Mr. Addison's Out-patients Department. She tilted her head to the left. There was hemiatrophy of the left side of the face. On straightening the head the right eye appeared elevated as compared with the left eye. This condition was made more manifest by turning the eye to the left, whereas, on turning the eyes to the right, it disappeared. With the Maddox rod a right hyperphoria was found, which was compensated by a 2-prism (angle of deviation) base down before the right eye. She had a 1·5 D. of hypermetropia in each eye and I ordered this with a 2-prism base down before the right eye and a 2-prism base up before the left eye. She wore this for a few months with no apparent effect upon the torticollis. Later, therefore, I tenotomized the right inferior oblique. I have seen her several times since, and, as far as I can make out, there is absolutely no improvement. The mother, however, is quite convinced that there is, and says that it is only when she is shy and nervous that she adopts

the posture. I think that myself, though whenever I have seen her, the head tilt, in relation to the body, seems just the same, perhaps in relation to the ground her head is less tilted, and while she holds her head straight in relation to the ground, she tilts her body now to the right.

If this is really so it should suggest that the operation has had some effect, and I am making her perform physical exercises to see if by this means her general position can be improved.

In the other three cases the head tilting is of much slighter degree, and the most noticeable feature consists in the movements of the eyes.

Case III.—J. F., boy, aged 6, tilts head slightly to the left; slight left hemiatrophy of the face; on holding the head straight and turning the eyes to the left the right eye goes up, the left down; in turning the eyes to the right there is parallelism; Maddox rod shows a right hyperphoria.

Case IV.—G. C., boy, aged 4; slight tilt to the right; very slight asymmetry of the face; eyes turned to right, right eye goes down, left eye goes up; eyes turned to left, parallelism; Maddox rod shows right hypophoria.

Case V.—O. P., girl, aged 8; slight tilt to left; eyes turned to left, right goes up, left goes down; eyes turned to right, parallelism.

In none of these five cases could I satisfactorily demonstrate diplopia. I used the candle test and the red and green glasses. I think perhaps the children did not fully understand what I was driving at; but they were quite definite in their answers when tested with the Maddox rod. Cases I and II had simultaneous perception; they saw "the bird in the cage."

It would seem that in all these five cases the same factor is acting, and I suggest that it is a weakness of the superior oblique—in Cases I and IV the left superior oblique, and in Cases II, III, V, the right superior oblique. In all these cases the head-tilting is to the same side as that on which the maximum separation of the eye occurs when the eyes are turned to that side. For example:—

Case I.—Head tilted to the right; eyes parallel when turned to the left, but when turned to the right the right eye goes down and the left eye goes up.

If one supposes that in this case the left superior oblique is at fault, then when the eyes are turned to the right, the left superior oblique will be acting as a direct depressor of the left eye. If it is weak in its action, this eye will tend to turn up relatively to the right eye, as the elevating action of the left inferior oblique will be unopposed. Tenotomy of the left inferior oblique should assist in preventing this elevation of the left eye in this position.

According to Abelsdorff, the torticollis in this case would still be due to weakness of the left superior oblique. But, if I interpret him rightly, his explanation would be that the head is tilted to the right so as to cause a roll of the eyes to the left, as in this position the left superior oblique is practically in a state of inaction.

Discussion.—Mr. MONTAGUE L. HINE said that he made an effort to exhibit a patient who had this condition of ocular torticollis, but failed. It was of interest as showing that in some cases treatment by means of prisms succeeded. This child had had a wry-neck since her birth. At the age of 3 months she was taken to Paddington Green Children's Hospital, where massage of the neck was carried out for some time, but without benefit. When she was 3 years of age the surgeons there wished to operate on her for wry-neck, but the mother objected, as she said there was no "lump in the neck," such as she understood "ought" to be there. At 8 years of age the child was brought to the Miller Hospital, where she was seen by Mr. Roth, who said he could not detect any wry-neck. But as her vision was defective he sent her on to him (Mr. Hine). She was then wearing four spheres and her head was tilted to the right. She had binocular vision and left convergent strabismus without glasses. With glasses the convergence disappeared. When her head was held to the right, the left eye was in the middle of the palpebral fissure; when the head was held straight the left eye turned up a little under the lid. He found she had, approximately, 4-prism diopters of left hyperphoria. Therefore he added 2° prisms to each eye: base down in the left eye, base up in the

right, and sent her back to Mr. Roth, who showed the patient at a meeting of the Section of Orthopædics in 1923.[1] She was very much better, but was still having massage of the neck. He saw the child six months afterwards, and the mother was very pleased with the result, which was immediate on the prisms being supplied. In June, 1924, Mr. Roth reported that it was an excellent result and that it was now difficult to demonstrate any inequality. It was thus evident that some of these cases could be put right with a small prism correction.

Mr. HARRISON BUTLER asked Mr. Doyne if he would describe the operation of tenotomy of the inferior oblique, which seemed to him to be not devoid of difficulty.

Mr. R. FOSTER MOORE asked whether Mr. Doyne had any theory to explain the hemiatrophy of the face in these cases. One was taught that in congenital cases the hemiatrophy was due to pressure of the sternomastoid and deep cervical fascia on the carotid artery; but that did not seem to him to be a very satisfying explanation, and clearly it was not the cause in these cases.

Mr. DOYNE (in reply) said he was much interested in hearing of Mr. Hine's success with prisms, and he himself tried prisms before he stepped in with the knife.

With regard to the operation, he supposed that he was lucky, because in the first case in which he operated he made an incision in the lower margin of the orbit through the skin, then through the fascia. The first time, when he got through the fascia, he saw the belly of the muscle at once, standing out. The second time he operated he made the incision in the same place, but in this case it was a little too external, and he did not find the muscle so easily. He therefore slightly extended the incision mesially, and then he saw it, like a band running into the fat. The first case rather surprised him by its ease.

With reference to the hemiatrophy of the face, he had no theory to put forward, except that in the two severe cases, and in others, the tilt had been there from the earliest years; therefore he took it that if that posture was adopted almost from birth, there was reason to suppose there would be a better blood-supply from the non-tilted side than from the other, and that side would be freer to develop more.

Plastic Repair of Perforation of Cornea.

By R. LINDSAY REA, F.R.C.S.

I DO not intend to bring before you a new operation for keratoplasty, but wish to show you the results which can be obtained from such operation, with improved technique.

There are two well-known methods for performing this operation: the first known as Da Gamma Pinto's operation, where a strip of conjunctiva is dissected up, freed at one end, and then the loose end pushed into the perforation; the second method—and the one which is undoubtedly the more satisfactory—is known as Kuhnt's operation. In this method the strip of conjunctiva is raised, but the attachments at either end preserved. The loose piece of conjunctiva is sutured in a position across the perforation.

My method for performing this operation is the following:—The eyelids are held apart by a speculum, or, in an extensive perforation, are retracted by the fingers alone, so as to remove all pressure from the globe. The conjunctiva is dissected from the limbus, say to half the extent of the circumference of the cornea. A straight incision is then made through the conjunctiva, 4 to 6 mm. from the limbus, the breadth actually varying with the size of the perforation in the cornea.

With a fine Graefe's knife the walls of the perforation are scraped, and the loose corneal epithelium around the edge of the wound is scraped away; if this precaution is not taken the epithelium may heal across, leaving a gap in the corneal tissue. This thin layer of epithelium will rupture within a few days. There should not be any pressure on the eyeball. In some cases I have observed the aqueous rising and falling with the pulsations of the retinal arteries.

[1] *Proceedings*, 1923, xvi (Sect. Orth.), p. 46.

The loose strip of conjunctiva is drawn over the wound, and held in position by a suture on either side of the cornea, as shown in the plate (fig. 1). The straight incision through the conjunctiva does away with the risk of stretching and of withdrawal of the strip from the wound. Soon the conjunctiva becomes adherent to the wound, and in four or five days the sutures will have cut out, but the lids should still be kept closed until ten days have elapsed. By this time new blood-vessels will have grown into the substantia propria of the cornea, supplying the small graft which is now filling up the wound. Fig. 2 shows the shrinkage of the conjunctiva, which I learned was an indication of nature that the portion not engaged in filling up the perforation should be removed. By passing a lacrimal probe beneath the loose conjunctiva and the periphery of the cornea, the strip is separated from the graft by blunt-pointed scissors, and only the edges of the small graft trimmed; the surface of the graft should not be touched.

The eyelids are closed for two days, and then allowed to move freely; it can now be seen that a plentiful supply of blood-vessels has grown from the limbus through the cornea, providing nourishment for the graft (see fig. 3). As the latter shrinks in size, there is need for fewer blood-vessels, and finally when the lids have smoothed the surface of the graft into conformity with the curve of the cornea, only a few remaining vessels in the substantia propria are seen (see fig. 4).

The four illustrations shown demonstrate the actual operation performed on the eye of a child who suffered from perforation of a corneal ulcer due to phlyctenular ophthalmia. Fortunately the iris was under the influence of atropine, and did not prolapse, but in the case of the man shown you this evening, the edge of the iris had become impacted in the perforation, but was readily separated a few weeks after the graft operation had been performed. This was done by using Lang's blunt-pointed anterior synechia knife.

When examining the cornea afterwards with a corneal microscope, a fine haze is seen in the clear cornea, immediately around the graft. This is not due to infiltration of aqueous, but is a structural change following the union of the conjunctival connective tissue with the tissue of the cornea. Blood-vessels in the deep portion of the cornea are seen to dip suddenly into this area, and then disappear into the graft.

The types of cases which I have found most suitable for this operation are:—

(1) *Traumatic Cases.*—Frequently, even when an interval of a day or two has elapsed, the operation has been performed successfully without sepsis; as a matter of choice, however, one would wish to do this operation as soon as possible after the injury If the iris has prolapsed through the perforation, the prolapsed portion should be caught by iris forceps, dragged forward and excised in order to avoid attachment of the iris to the graft, or to the edges of the perforation.

(2) *Cases of Perforating Phlyctenular Ulcers*, such as that of the boy I have illustrated.

(3) *Cases of Perforating Septic Ulcers.*—I have carried out this method in these cases and have not had a single failure.

It has been observed by many that after a peritomy has been performed, and the conjunctiva drawn over a septic ulcer, healing has rapidly followed. This has been my experience, and so I do not hesitate to include perforating septic ulcers in the above list.

Discussion.—Mr. T. HARRISON BUTLER asked why Mr. Rea did not adopt the more recent method of keratoplasty which Professor Kuhnt described before the war. That method consisted in cutting a ribbon of conjunctiva from the appropriate part of the conjunctiva and bringing it across the cornea. This ribbon, about 5 mm. wide, would be slightly too long, and Kuhnt tucked it in at one end. He undermined the conjunctiva a little in order to repair the defect left by the cutting of the ribbon. He (the speaker) had tried this method himself in some cases for covering perforations, and successfully.

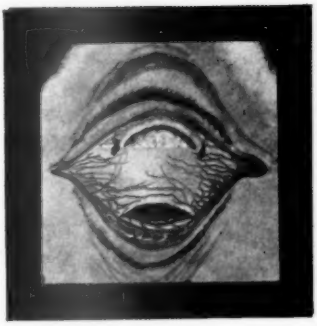


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

Mr. RAYNER BATTEN said that his method of dealing with repair of corneal lesions, whether from injury or ulceration, was based on the old operation of peritomy. The operation of peritomy had been generally abandoned, though he was at a loss to know why. A colleague of his did not even know what the operation was, and another had never seen it done. Yet, after considerable experience of the operation for the last twenty years or more, he had never experienced a reverse. The results obtained had rarely disappointed him. The operation, as he did it, was much the same as described by Critchett and Teale. It consisted in dividing the conjunctiva about 3 mm. from the cornea, removing the band surrounding the cornea as close as possible to it, and then scarifying the surface surrounding the cornea with one blade of the scissors, so as to divide any small vessels left. That was the complete operation as described by George Critchett and Teale. That was often all that he did when there was no surface injury to the cornea; but where there was any loss of substance in the cornea, or injury to it, he stitched the conjunctiva over the cornea and completely covered it; this, as far his as experience went, could be safely done with clean or dirty ulcers. Of course, adhesion of the conjunctiva to the cornea might occur, but that was no drawback. The attachment to the cornea was generally by means of a bridge of conjunctiva, this could easily either be separated from the cornea, or better still, as Mr. Lindsay Rea had pointed out, divided, leaving the attached portion of the conjunctiva to flatten down into the cornea.

Critchett and Teale adopted various methods for prevention of the too rapid re-attachment of the conjunctiva, such as dissecting back the conjunctiva and making crucial incision in the conjunctiva. His (Mr. Rayner Batten's) modification of the operation (if it was his) consisted in dissecting back the conjunctiva freely, as if for an excision, then stitching it together over the cornea and burying the eye completely.

One advantage of this modification was that it delayed the re-attachment of the conjunctiva, and gave time for the epithelium from the corneal margin to spread over the exposed area of the sclerotic, and thus form a band of scar tissue against the re-formation of corneal vessels. But its chief advantage was seen in cases of extensive and progressive ulceration of the cornea. Indeed, in these cases the advantage was twofold: (1) the nutrition of the cornea was improved, and (2) an adhesion to the ulcerated surface was generally formed. After the eye had recovered he had generally detached this band of conjunctiva. He was led to adopt this form of treatment by noticing that the corneal condition often improved during the actual operation, i.e., it looked brighter and more healthy; also he had noticed that, in some cases, whilst the first incision was painful, as the operation proceeded the pain became less, and he thought that by covering the ulcerated surface entirely, it would give it a period of complete rest.

The effect of Mr. Rea's modification and improvement was to encourage the attachment of the conjunctiva to the cornea over a large surface, and to leave the conjunctiva to adhere and become part of the cornea. His brilliant results opened up a wide field for further extension of this form of treatment.

The method of healing of the peritomy wound was interesting. The conjunctiva re-attached itself generally within a week, not to the margin of the cornea but about 2 or 3 mm. away, the intervening space being covered with epithelium apparently derived from the corneal margin and firmly attached to the sclera. It was probably the firm band of tissue which benefited the cornea by constructing its superficial vascular supply. It must nevertheless be admitted that it would be a very awkward condition to find in the event of the patient developing either cataract or glaucoma. In the case of the former there would be no conjunctival flap and in that of the latter it would be impossible to do a satisfactory trephine operation.

Mr. G. H. POOLEY said, in warning, that he used to draw conjunctiva freely over the cornea, and at first he rather liked the results; but in one case the conjunctiva refused to go back, and he could not get it back; it adhered to the perfectly sound corneal epithelium everywhere over the whole cornea. Since then he had been very careful about using the method.

Sir ARNOLD LAWSON (President) said he did not quite understand Mr. Rea's reference to pressure; he said he did not allow pressure after he had closed the wound. Did he leave the eye open, or keep it shut?

Mr. REA (in reply) said he did not use the speculum, but kept the lids retracted with the fingers, i.e., at the beginning. His point was to get the new piece of substance to grow in to

the unformed gap in the cornea. Afterwards the lids were closed and bandaged up. And he was not then so particular about pressure. It was necessary to keep the instrument far away from the lens. In most cases the iris had been up against the perforation, or had prolapsed into it. If in any case the iris had come through, he snipped it away. But the pupillary margin of the iris was caught in one case, and a little of the iris surface was caught in the back of the graft, as could be seen.

Mr. A. F. MacCallan said that the natural repair of gaps in the cornea took place by adhesion of the iris to the lips of the wound and their vascularization from the iris vessels. He had seen many cases in which large gaps in the cornea had been repaired naturally by adhesion of the iris. In certain cases of descemetocele he had easily obtained repair of the cornea by snipping through the membrane and getting the iris in contact with the wound. It required a subsequent iridectomy to be done, as a prophylactic against the development of secondary glaucoma.

Section of Ophthalmology.

President—Sir ARNOLD LAWSON, K.B.E., F.R.C.S.

Coloboma of the Lens.

By M. H. WHITING, O.B.E., F.R.C.S.

AT first this case was thought to be one of congenital dislocation of both lenses, but on examining the lens it could be seen that the contour was straight, and in places a little concave instead of being convex as it would be if it were a congenital dislocation. It was difficult to know what to do with it, as the patient saw $\frac{6}{18}$ and $\frac{6}{12}$ respectively with correction. The best vision was obtained through the aphakic part of the pupillary area. I decided to needle one of the lenses, which had a considerable opacity in the pupillary area, and did so; but I do not think the patient sees much better since that operation was performed, though certainly he does not see worse.

Posterior Lenticonus.

By M. H. WHITING, O.B.E., F.R.C.S.

THIS patient had a congenital deformity of the posterior part of the lens, and the condition is shown very well with the slit-lamp. The alteration in the contour of the lens can be definitely made out; it has almost a nipple on its posterior surface.

Perforating Wound of the Right Eye and Division of Upper Lid.

By F. A. JULER, F.R.C.S.

History.—Patient came to the Royal London Ophthalmic Hospital ten days after receipt of the injury, with large prolapse of iris through wound of cornea and limbus, and gaping V of the upper lid.

January 27, 1926.—Iris partially abscissed, vitreous loss. Lid repair.

February 3.—Small prolapse of iris removed, vitreous loss.

February 15.—Tag of vitreous cut off, carbolized.

March 6.—Slight notching of upper lid margin. No trichiasis. Right eye quiet, no keratitis punctata; anterior synechia of iris, lens clear. Right vision $\frac{6}{24}$, with sph. + 0·75, cyl. − 4 ax. 170 = $\frac{6}{9}$.

Points of special interest are the following:—

(1) Large perforation of globe. (2) Ten-days-old prolapse of iris. (3) Loss of vitreous. (4) No conjunctival flap being placed over wound. (5) Rapid healing with little reaction.

I have shown this patient to illustrate how much the eye can stand in the way of a perforating injury.

Discussion.—Mr. GRAY CLEGG said he had a somewhat similar case, in which the lids were slit up as the result of a motor accident, and there was a tremendous gash in the sclera. He stitched the wounds into position and satisfactory healing took place. A detachment of the retina, however, came on months later. That was a possible sequel in this case also. Ophthalmic surgeons were not now so pessimistic about the outcome of wounds in the eye as they formerly were.

Mr. JULER (in reply) said that a fibrillary tag of vitreous 1 cm. long was hanging out of the scar; this was cut short, and Mr. Muirhead touched the base with carbolic, in order, he thought, to stimulate the epithelium to cover the raw area.

Case of Neuro-retinitis.

By F. A. JULER, F.R.C.S.

THIS girl, aged 22, came in December to the Royal London Ophthalmic Hospital to have her eyes tested. Vision was good in each eye. Hæmorrhage in her retina was found, and further examination revealed definite neuro-retinitis. In one eye were two "cotton-wool" opacities, also one or two hæmorrhages. Œdema of the disc was marked: I have no doubt it was a definite œdema, not a congenital condition. She was admitted to St. Mary's Hospital, and the physician (Professor Langmead) was surprised at the good condition of her kidneys. The tests which were carried out showed that the blood-urea was within normal limits, and the urea-concentration tests showed that renal efficiency was good, though there was a defect in the quantity of urine excreted. In bed, her systolic pressure was 230 mm., and the diastolic was 210 mm. In the urine there was a trace of albumin; no casts; sp. grav. 1010. The case was therefore interesting in that though she had renal retinitis, the efficiency of the kidneys was good, and the hyperpiesia was the only condition found to account for what was seen in the retina and the disc.

Sympathetic Ophthalmia.

By F. A. JULER, F.R.C.S.

PATIENT a boy, aged 12.

History.—Was struck by a piece of glass on *January* 7, 1926.

On admission, January 13.—Right eye normal; vision: $\frac{6}{6}$ unaided. Left eye: large prolapse of iris through a perforating wound at the limbus. Eye almost white. Tension soft. Vision: $\frac{6}{24}$ unaided.

X-ray Examination.—No evidence of intra-ocular foreign body.

Operation, January 13.—Abscission of iris prolapse, under chloroform and ether. Conjunctival flap.

Extensive hyphæmia in left eye after operation, which took a long time to clear up. Eye ever since the operation somewhat irritable. No suggestion of sympathetic trouble until February 12, when a clump of keratitis punctata was noticed in right eye. No keratitis punctata in left eye.

Treatment.—Atropin. Hot bathings. Dental treatment. Weekly injections of 0·3 N.A.B. since February 12. Ultra-violet ray treatment.

February 26.—One small patch of choroiditis in right eye noticed.

March 3.—Vision: Right: $\frac{6}{18}$ ptly.; left: $\frac{6}{60}$ just.

March 6.—Vision: Right: $\frac{6}{12}$; left: $< \frac{6}{60}$.

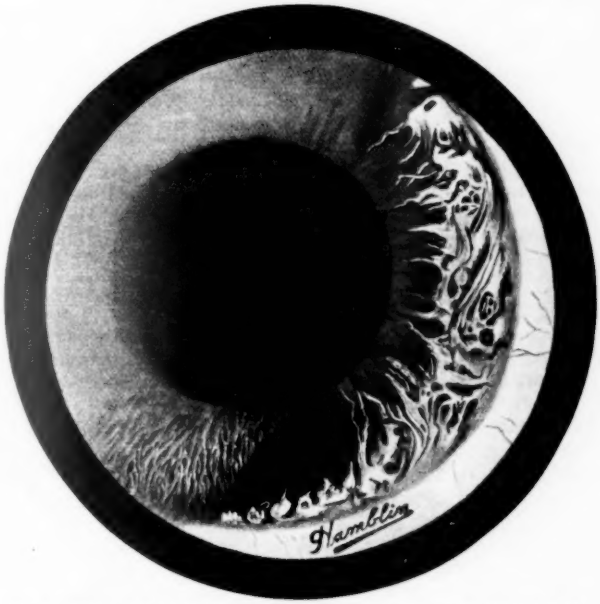
March 12.—Vision: Right: $\frac{6}{24}$ with $-$ 0·75 sph.; left: cf. 2 ft.

This case is shown for three reasons. First, a sympathetic disease started although no keratitis punctata was present in the exciting eye. It has been my custom to regard the absence of keratitis punctata as an assurance that sympathetic disease will not come on, but this case shows that such a conclusion may be fallacious. A second reason for showing the case is that there appears to be no iris in the wound. Abscission of the prolapsed iris was done, yet, in spite of that, sympathetic ophthalmia has ensued. The third reason is that at times in the right eye the vitreous has been clear, and below one can see two or three small foci, which seem to be sympathetic choroiditis. Should the exciting eye of this patient now be removed? When the sympathetic ophthalmia started, the exciting eye was left, as it was thought that that eye might eventually have the better vision of the two. A colleague of mine and I myself consider that probably the excision of the exciting eye, if carried out, would not influence the course of the trouble in the sympathizing eye.

A Case of Infantile Glaucoma with imperfect Development of the Angle of the Anterior Chamber.

By IDA C. MANN, F.R.C.S.

PATIENT, a girl, aged 8. Nothing was known of her condition until a year ago, when she was noticed at school to have defective vision. On examination, vision was found to be $\frac{6}{24}$ improved to $\frac{6}{12}$ in each eye by low minus spheres. Both optic discs were deeply cupped. The tension was slightly raised. The pupils reacted to light and accommodation but it was at once noticed that the iris, especially that of the left eye, was abnormal. In the left eye the base of the iris in the outer half of its circumference is imperfectly separated from the back of the cornea, the region of the angle of the anterior chamber appearing to be filled with a loose meshwork of tissue containing a few very fine blood-vessels, and resembling in structure the stroma of the iris. Strands of this tissue pass between the back of the cornea and



Drawing of a portion of the iris of the left eye showing imperfect differentiation of the angle of the anterior chamber.

the front of the iris where they run inwards on to the normal iris stroma and blend with it. These strands are seen in the drawing, in which, however, the normal iris stroma is represented a good deal darker than it should be, so that the contrast is rather too marked.

In the right eye there was a strand of persistent pupillary membrane; the angle of the anterior chamber appeared shallow, but it was difficult to make out whether there was any definite abnormality. That there was a functional abnormality was evident from the cupping of the right disc and the diminution of visual acuity. In neither eye were there any signs of inflammation, past or present.

The child was treated with eserin but the tension remained slightly raised and vision continued to deteriorate. Corneo-scleral trephining was therefore performed on the right eye nine months ago with good results. The tension became normal and the visual acuity improved to $\frac{6}{9}$. This improvement has been maintained. It was therefore decided to perform a similar operation on the left and this was done a fortnight ago, with, as far as can be seen at present, a good result.

[*May* 14, 1926.

Black-spot Choroiditis.

By RAYNER D. BATTEN, M.D.

I WISH to call your attention to a form of fundus lesion, which I do not think has received adequate attention from either the clinicians or the pathologists. Central black spot is described as a lesion in myopia; it is commonly associated with that disease and a frequent cause of the final loss of vision. It is not, however, limited to myopia, but occurs in hypermetropia. It commonly occurs at the macula, but it is not confined to the macula, but *is* limited, as far as my experience goes, to the central area, i.e., the area embraced by the superior and inferior temporal vessels.

Clinically, I recognize three forms of black-spot choroiditis:—

(1) The generally recognized form usually accompanying high myopia, in which the onset is acute: it occurs at the macula, and the whole process takes place with dramatic suddenness, so that in a few days after the failure of sight the black spot with its surrounding area of choroidal atrophy is found fully formed. This may or may not be accompanied by hæmorrhage, but hæmorrhage in my experience has never been a marked feature.

(2) In the second form the onset is also generally acute, so far as failure of vision is concerned, but the fundus changes are of a different character.

(*a*) The macular area may be difficult to focus, or it may appear as a pale area, when first seen; subsequently faint, diffuse hæmorrhage may be found, and later the typical black centre of pigment with its surrounding area of choroidal atrophy, but this may take weeks or months in formation.

(*b*) The choroidal area after its first formation tends to get smaller, and while central vision may remain lost and impaired the eye may regain some general vision and usefulness.

(3) The third form is not always at the macula, though I have not found it outside the central area; for this reason possibly there may be no history of sudden onset. Some examples of this form have been found accidentally, but they have many points in common with the other two classes and are interesting in that connexion, and may help to throw light upon the nature of the lesion.

Mr. RAYNER BATTEN showed a large number of Fundus Drawings illustrating the different points in his paper.

Discussion.—Mr. J. H. FISHER said everyone recognized that the nutrition of the retina at the macula was a matter of supreme importance to vision, and, with that object in view, the capillary network was more dense and efficient in that situation than in any other part of the choroid coat. The pigmentation which had been seen in Mr. Batten's cases was, he presumed, an accumulation derived from the pigment layer of the retina, and the disorder of pigmentation was, presumably, the result of imperfect nutrition of that layer by the chorio-capillaris, on which it depended.

The striking difference between the first and second classes of cases shown seemed to be, that in the arterio-sclerotic cases there was atrophy of the chorio-capillaris, conspicuous over the central, generally circular, area, with accumulation of pigment at its periphery, and little or no pigment where the chorio-capillaris was obviously deficient over the major portion of the area. But in the myopic cases there was an area of choroidal atrophy forming a framework, and in the centre of that area was an accumulation of pigment.

Looking for an explanation of this major difference, on a capillary basis, he thought that in the arterio-sclerotic cases obstruction of the branch of an artery which conveyed blood to the chorio-capillaris in the situation of the macula occurred and the blood-supply of that area of chorio-capillaris was cut off except at the periphery, so that the major portion of the area, in the arterio-sclerotic cases, had no nutrition at all for the pigment layer; and perhaps a rapid disappearance at the retinal layers, including the pigment layer, resulted. But at the periphery, where the chorio-capillaris was functioning, though badly, the cells would resent the want of perfect nutrition and there would be an accumulation of pigment at the spot concerned.

With regard to an explanation of the myopic cases, one knew the liability, in highly myopic eyes, for fissures to occur in the choroid coat, and if, in the macular area, a combination of fissures formed a circular crack in the choroid, there resulted a condition which was comparable to rupture of the choroid, in which there was no formation of pigment over the fissure itself. One would find the chorio-capillaris functioning to some extent over the more central portion of the area concerned, and there the deficient circulation might yet be sufficient to supply some nutriment to the pigment layer; there would also be an accumulation of pigment in the central portion of the area concerned.

That hypothesis might explain the main feature of difference between the two classes of case; it was a purely hypothetical statement, but might afford a basis for discussion.

Mr. E. TREACHER COLLINS said he had seen several cases with black spot at the macula in cases of high myopia, and he thought it was generally recognized that they were due to hæmorrhage. He had seen instances in which at first what looked like a hæmorrhage subsequently passed into a black spot. The hæmorrhage was probably from choroidal, not from retinal vessels, and that was why it remained as a deeply pigmented patch. Moreover, the history of onset in these cases with a black spot was always sudden failure of vision; pigmentation due to melanin in the retina would not come on suddenly. This was one of the complications to which high myopes were liable. It led to a sudden loss of central vision, which was naturally very alarming to the patient. He had watched such patients for several years, and he had never seen the retina become detached, or any further loss of vision occur. We could offer these patients the consolation that though their central vision was permanently lost no further deterioration would occur.

He thought the explanation of the appearance of the white area around the black spot was that, at first, choroidal atrophy occurred at the macula in association with myopia, the choroidal vessels becoming very thin and stretched. Then one of them ruptured and hæmorrhage occurred.

The other cases Mr. Batten showed might arise from a variety of conditions. One class of case associated with choroidal atrophy was depicted in Jaeger's atlas and spoken of by Nettleship as central areated choroiditis. In the central area there was marked sclerosis of the choroidal vessels. The peculiar features about these cases were that the sclerosis was confined to the choroidal vessels which went to the macula, not affecting the surrounding parts. And that condition was symmetrical in the two eyes. He had not heard of any explanation to account for these peculiarities.

Mr. H. R. JEREMY said he thought some of these cases must be due to hæmorrhage, especially in the case of high myopes. He had, last year, a case in which hæmorrhage seemed to be the explanation. The patient was a boy, aged 17, with myopia − 15 in one eye, − 19 in the other. He was blind in one eye, and while at a dance he suddenly became blind in the other. In one eye there was a black spot at the macula, and in the other a large hæmorrhage below the macula. He ordered the patient to bed for six weeks, and at the end of that time he recovered sufficient vision to get about. In course of time the hæmorrhage became black.

Mr. J. F. CUNNINGHAM said he had had a female myope under his care since 1910. She had vision §, with − 10 or − 11, and she developed coal-black spots rather rapidly. In

one eye she had a partial detachment. Since the war, in place of the black spot, there had appeared a large area of choroidal atrophy, with sclerosis of vessels. He did not know whether Members found that a black spot did disappear.

Mr. RAYNER BATTEN (in reply) said the peculiar point about the black spot choroiditis cases he showed was the dramatic suddenness with which they occurred and the rapidity with which the black spot was formed. He had found that a difficulty in arriving at an explanation. If it was preceded by a hæmorrhage, it might be that the pigment became dislodged by the hæmorrhage.

Section of Ophthalmology.

President—Sir ARNOLD LAWSON, K.B.E., F.R.C.S.

The Visual Field in Atheroma of the Retinal Vessels.

By RANSOM PICKARD, C.B., C.M.G., M.S.

THIS subject has been dealt with so fully by Mr. Foster Moore [1] that it may seem superfluous to write anything further upon it. The starting point of the present work was the clinical fact that in some cases of early atheroma a lowering of central vision to $\frac{6}{8}$ or $\frac{6}{9}$ could be observed, for which no other explanation than the atheroma was forthcoming. I had begun to investigate the fields in detail, to see if a lowering of visual acuity occurred in other parts of the field than the fixation point, before I had an opportunity of reading the papers of the above-named author. My work has been continued, mostly upon what appeared, ophthalmoscopically, to be early cases of atheroma, in order to endeavour to detect the earliest effects upon the visual fields. Later cases are included in this paper, to make, as far as possible, a continuous series; each case being allotted a letter, by which it is named.

In order to eliminate as far as possible other conditions which might affect the results, only cases which are free from serious affection of the media are included, with the exception of Q, which showed distinct lens opacities; accounting for a vision of $\frac{6}{18}$ in the right eye. As the case of this eye is brought into the paper to show the want of relationship between the field and the arterial condition, the cataract does not invalidate its use in exemplification.

With the exception of L and R, no cases with fundus hæmorrhages, or white or yellow patches, were included, so that any local effect upon the retinal elements due to these might be excluded.

Only those patients are included who showed themselves reliable observers with short time reactions, a most important point in field charting.

Thus the abnormalities in the fields discussed may fairly be assumed to be due directly to the abnormal vessels and not to any secondary lesions. Twenty patients and in all twenty-nine eyes are dealt with. In four cases one eye only could be investigated, because the other eye had serious trouble owing to advanced effects of atheroma; in one there was iritis, in another vitreous opacities, in four others time would not allow of the detailed investigation of both fields, and in another the fundus was normal. In nine, both eyes are included in this paper.

METHODS.

(1) Central acuity is recorded as obtained by correcting glasses.

(2) The fields were ascertained on Bjerrum's screen at 1 metre, usually for $\frac{1}{1000}$ or $\frac{3}{1000}$ (Traquair discs), for larger objects in fields much reduced.

(3) McHardy's perimeter was used for 5 and 15 mm. objects (registered as $\frac{5}{3000}$ and $\frac{15}{3000}$).

The fields obtained by (2) and (3) are combined on one chart.

(4) In a few cases a 4-volt lamp or candle was employed outside the $\frac{15}{300}$ area, to see if the retina was sensitive to a strong stimulus.

TABLE OF CASES.

Case letter	Sex	Age	Eye recorded	Corrected vision	Systolic B.P.	Urine	Condition of unrecorded eye	Duration of observation
A	F	65	L	$\frac{6}{6}$ (4)	140	...	Slight atheroma	1 month
B	M	71	R	$\frac{6}{5}$ (5)	190	...	Hæmorrhage; superior temporal area	4 months
C	M	59	L	$\frac{6}{5}$	195	1010, no albumin	Retinal venous thrombosis	Once
D	F	67	R	$\frac{6}{5}$ (2)	...	...	Slight atheroma	Once
E	M	69	L	$\frac{6}{9}$ (5)	152	...	Very slight atheroma	Once
F	F	57	R L	$\frac{6}{4 \cdot 5}$ (4) $\frac{6}{12}$ (2)	210	1004, no albumin	...	1 yr. 1 mth
G	M	67	R L	$\frac{6}{6}$ (5) $\frac{6}{6}$ (4)	160	...	...	Once
H	M	38	R	$\frac{6}{4 \cdot 5}$ (3)	160	...	Iritis	2 months
I	F	64	R L	$\frac{6}{9}$ (5) $\frac{6}{9}$ (2)	...	...	...	Once
J	M	55	R	$\frac{6}{9}$	260	Cloud of albumin	Hæmorrhages; superior temporal area	1 yr. 3 mos.
K	F	69	L	$\frac{6}{5}$ (4)	...	...	Slight atheroma	Once
L	F	50	R	$\frac{6}{24}$	215	1006, no albumin	Retinal hæmorrhages, &c.	2 yrs. 3 mos.
M	M	67	R L	$\frac{6}{60}$ $\frac{6}{6}$	190	1010, slight cloud of albumin	...	9 months
N	M	76	L	$\frac{6}{5}$ (3)	...	...	Vitreous opacities, &c.	Once
O	M	78	R L	$\frac{5}{9}$ $\frac{6}{12}$ (4)	...	...	...	Once
P	F	52	R L	$\frac{6}{18}$ $\frac{6}{12}$	160	1008, faint cloud of albumin	...	2 yrs. 2 mos.
Q	F	75	R L	$\frac{6}{18}$ $\frac{6}{9}$ (3)	155	...	...	Once
R	F	66	L	$\frac{6}{6}$ (4)	160	...	Normal	Once
S	F	65	R L	$\frac{6}{18}$ (2) $\frac{6}{36}$ (1)	240	...	...	5 years
T	F	62	R L	$\frac{6}{9}$ $\frac{6}{12}$	175	1016, no albumin	...	5 years

(5) Graphs of the visual acuity along the horizontal meridia were constructed in some representative cases, to show to what degree the acuity was affected in the various parts of the fields.

(6) Graphs were also drawn to show the percentage loss in various parts of the fields. Taking the normal acuity in every part of the horizontal section of the field as 100 per cent., the graph for a normal eye becomes a horizontal line at the 100 per cent. level. The graphs for the abnormal fields show by their depression below this the percentage loss, by their height above the zero line the percentage remaining.

Groups.

The cases have been divided arbitrarily into three groups, according to the loss of the $\frac{5}{300}$ field. This has been taken as the criterion because it is the smallest object on the McHardy perimeter with which a full field can be obtained normally. The third group is fairly well separated from the first two by more advanced ophthalmoscopic appearances.

The full normal fields for $\frac{5}{300}$ in the eight principal meridia, if added together and divided by eight, give an average angle of 65° from the fixation point. The present cases are divided into three groups, thus:—

Group (1) Average angle for $\frac{5}{300}$ over 50° for better eye if both recorded, with concentric diminution of field; (2) Between 50° and 45° for better eye with concentric diminution; (3) Below 45°, with concentric or excentric diminution. M (left eye) was an exception when first seen, in that the average angle was 48·5°.

A glance at the table of cases shows at once there is no correspondence between the severity of the eye condition and the blood-pressure. In all three groups there are wide variations, from almost normal readings up to very high pressures. There is no correspondence between increasing age and severity of disease; nor are the cases sufficient in number to warrant any deduction on this point. Thus the classification rests mainly upon the ophthalmoscopic differences, especially on the latter in the third group.

First Group (Cases A to F).

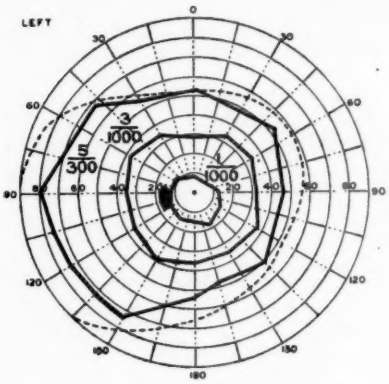
Very slight fundus alterations. In all the veins are slightly full, some partly cut by the arteries. In A, B and C the arteries are of normal calibre, with normal reflexes. In D the arteries were generally narrowed, especially the superior temporal near the disc, but there is no corresponding sectoral loss in the field. In E the arteries were tortuous, not narrowed. In F some arteries were narrowed, but again with no sectoral loss in the field.

The $\frac{1}{1000}$ field is decreased in all of this group, four having receded centrally to the blind spot area, two others being flattened above. The $\frac{3}{1000}$ field boundary lies between the 30° and 40° circles in all except the lower edge of F (January 23, 1925), where it reaches 42°.

The $\frac{5}{300}$ field is slightly but definitely contracted, most markedly so in F. There is slight enlargement of the blind spot in B, C, D and E. Central vision is slightly lowered in three cases.

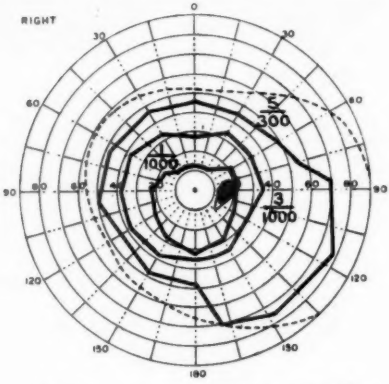
Thus the greatest incidence of loss is in the $\frac{1}{1000}$, least in central acuity. This area ($\frac{1}{1000}$) seems particularly liable to attacks upon it, for Traquair [2] and myself [3] have shown independently that this area is frequently diminished very early in chronic glaucoma.

Graphs of A and F illustrate these points in another way. They show how every part of these fields is affected but with comparatively slight loss in the central acuity. It is important to realize that in these apparently slight cases there is much more damage than would appear from the ophthalmoscopic appearances.



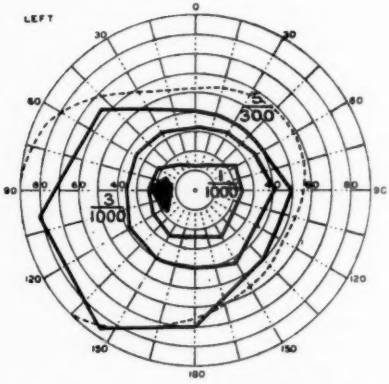
7.4.25. Blind spot $\frac{3}{1000}$

CHART A.



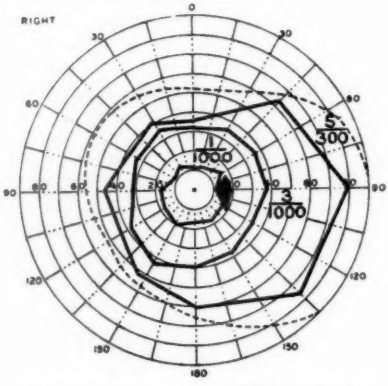
14.10.25 Blind spot $\frac{1}{1000}$ $\frac{3}{1000}$

CHART B.



25.8.25. Blind spot $\frac{1}{1000}$

CHART C.



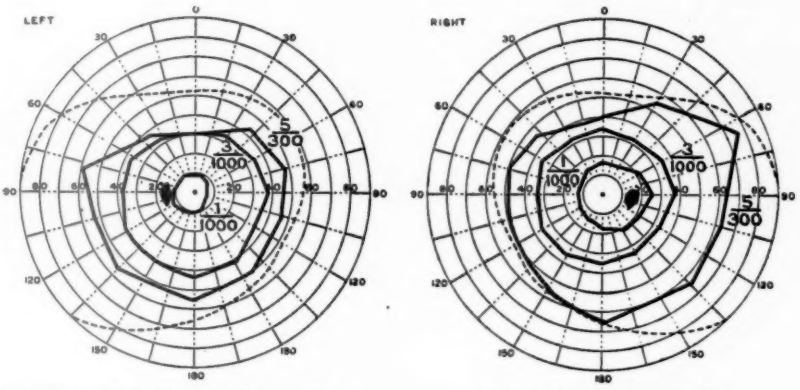
27.8.25 Blind spot $\frac{3}{1000}$

CHART D.

3.4.24 Blind spot $\frac{2}{1000}$ $\frac{3}{1000}$

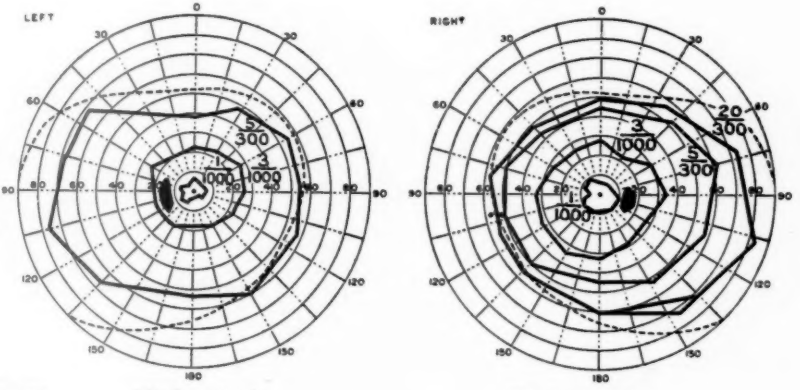
CHART E.

The percentage graphs of A and F show the same points but are interesting as showing the variation in the proportions in which the various parts of these sections are affected. But though there is a tendency to greater loss towards the periphery, there are great irregularities in the amounts lost in different parts of the field, very much more than would be anticipated from the graphs of the visual acuity of these



23.1.25 V $\frac{6}{12}$ (2) Blind spot $\frac{3}{1000}$ V $\frac{6}{4.5}$ (4) Blind spot $\frac{3}{1000}$

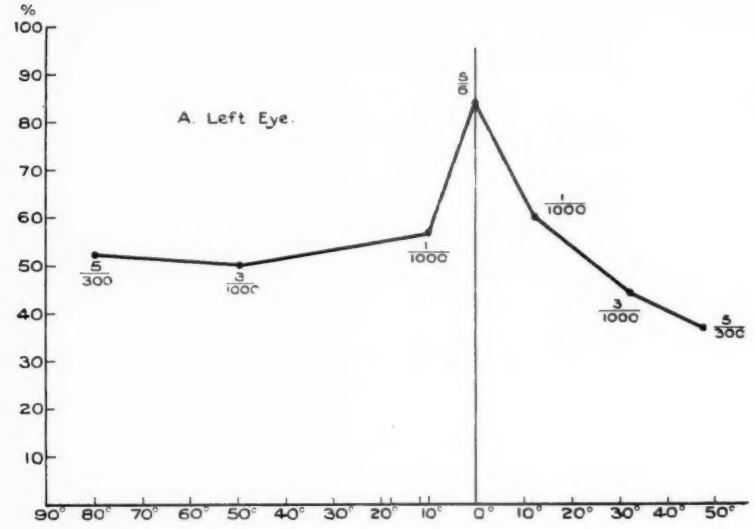
CHART F.



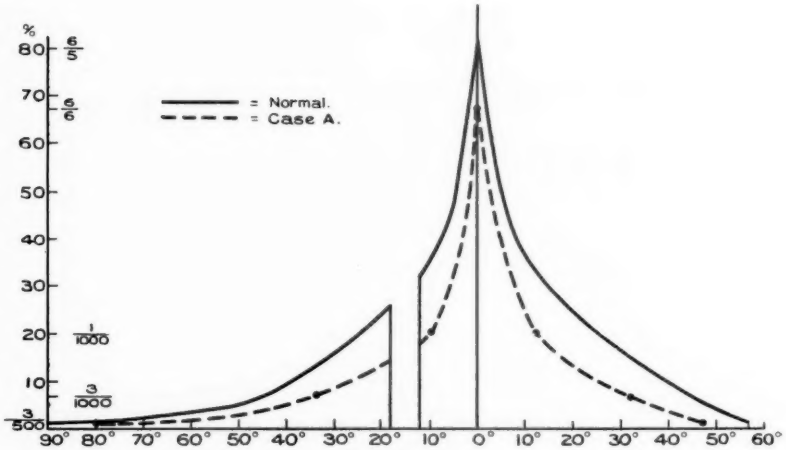
3.3.25 Blind spot $\frac{3}{1000}$ Blind spot $\frac{3}{1000}$

CHART F.

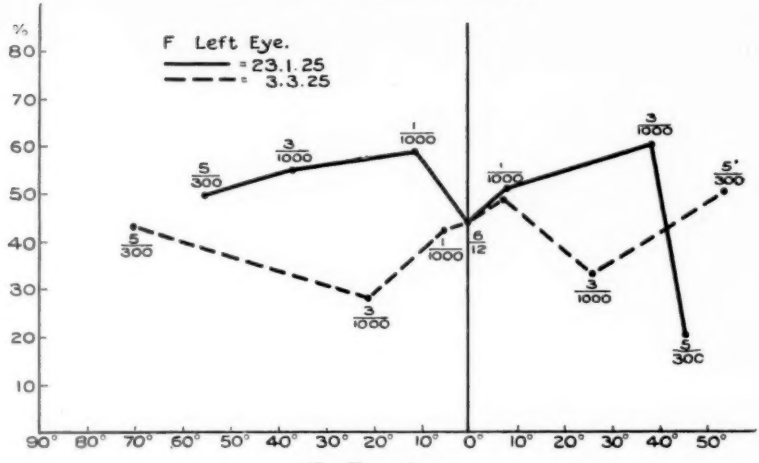
cases. In the percentages the survival of the central acuity dominates the chart when this is $\frac{6}{9}$ or more. It should be noted that these alterations are not concentric with the blind spot, as it should be if they were merely dependent upon the obstruction through the central vessel, but suggest that the field loss results from at least two factors—the blood-supply and the local resistance to deterioration.



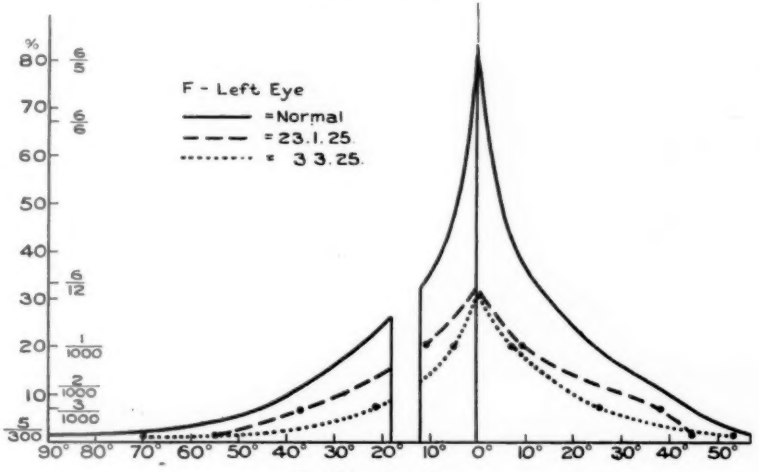
A.—Percentage.



A.—Visual acuity.



F.—Percentage.



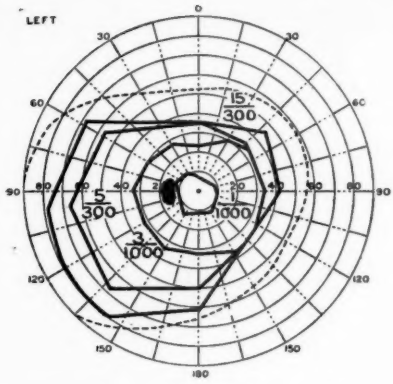
F.—Visual acuity.

Second Group (4 *Cases, G to J*).

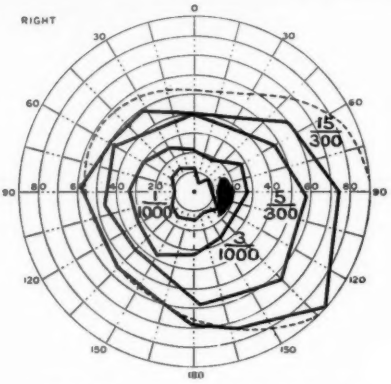
These cases show a further diminution of the $\frac{5}{300}$ field. This group also shows a distinct loss for the $\frac{1.5}{300}$ field. In H and J a 4-volt lamp and a candle respectively could be seen only in part of the field outside the $\frac{1.5}{300}$ outline, the remainder of its field corresponding with $\frac{1.5}{300}$, so that these two cases show an absolute loss of function at the periphery.

The $\frac{3}{1000}$ field maintains its size fairly well in this group, but the $\frac{1}{1000}$ is further diminished. There is no sectoral loss until the $\frac{1}{1000}$ field is reached; G (right eye) and H show slight irregular loss at this boundary. G, H and J show enlargement of the blind spot. Central vision still remains good in this group.

The ophthalmoscope shows the veins cut by the arteries in all the cases; in only two (G and J) are the arteries narrowed. When J was first seen they were of normal appearance; six months later the superior nasal vessels were narrower. The fields had become smaller during this period, but concentrically, so that there was no sectoral defect corresponding to this group of vessels.

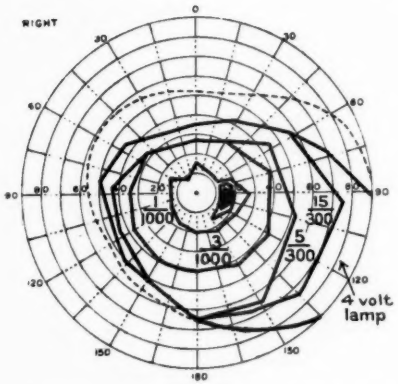


23.11.25. Blind spot $\frac{3}{1000}$



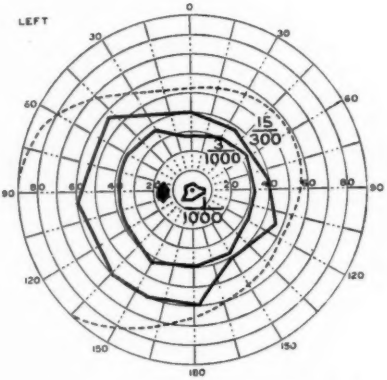
23.11.25. Blind spot $\frac{3}{1000}$

CHART G.



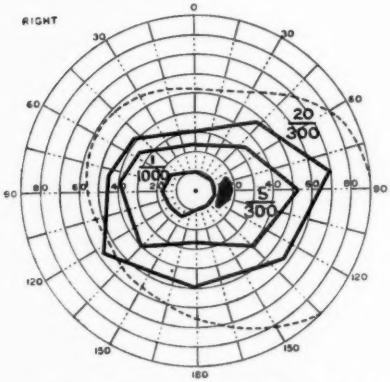
1.12.25. Blind spot $\frac{3}{1000}$

CHART H.

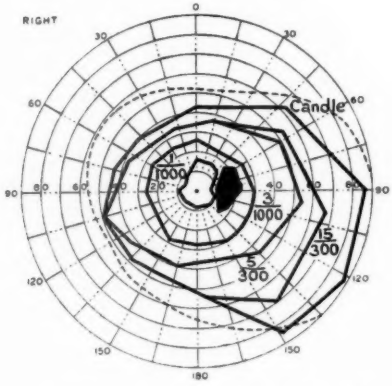


26.3.25. Blind spot $\frac{3}{1000}$

CHART I.



27.2.25. Blind spot $\frac{3}{1000}$



1.1.26. Blind spot $\frac{3}{1000}$

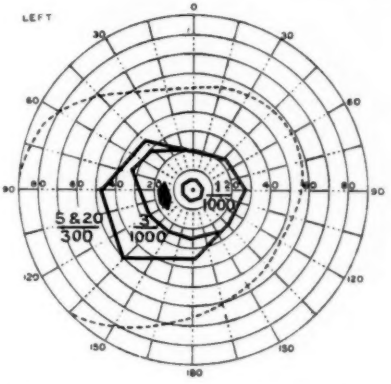
CHART J.

Third Group (10 *Cases, K to T*).

These cases are distinguished by still greater general diminution and, in some, by sectoral defects.

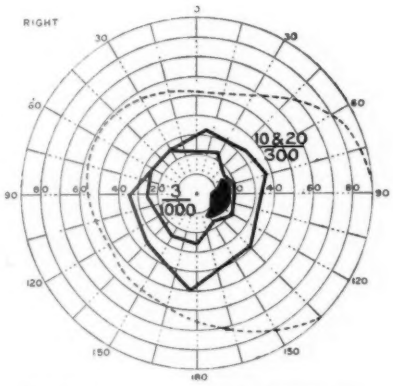
With the exception of K, all the cases of this group show narrowing of the retinal arteries, some have bright reflexes, others are nearly obliterated; the details are given in the clinical abstracts.

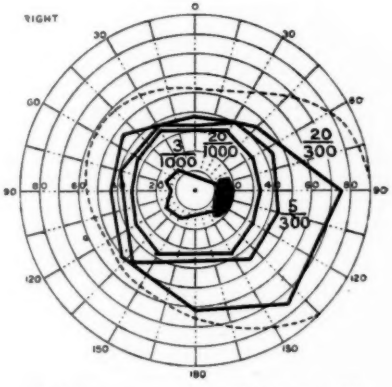
K, L, M, O and P show no sectoral defect in the margin of the $\frac{5}{300}$ field, although the fields are by no means concentric with the normal field. In these cases the $\frac{3}{1000}$ field shows marked diminution in L and M, being internal to the blind



3.3.25. Blind spot $\frac{3}{1000}$

CHART K.





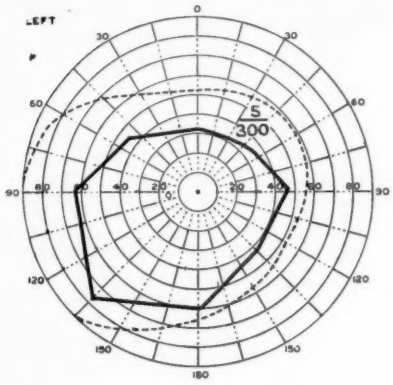
25.4.24. Blind spot $\frac{3}{1000}$ 27.10.25. Blind spot $\frac{3}{1000}$

CHART L.

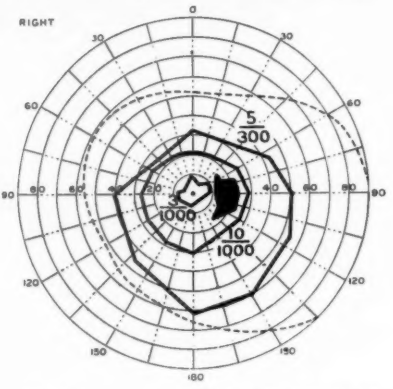
spot. In the cases where the $\frac{1}{1000}$ was charted it was very small; in L and M vision was too poor for this to be charted; while P is distinguished by the extreme concentric contraction for all objects.

In K, L and M the blind spots were distinctly enlarged. Central vision was much lowered in L, M and P; in K, N and O not much or not at all affected.

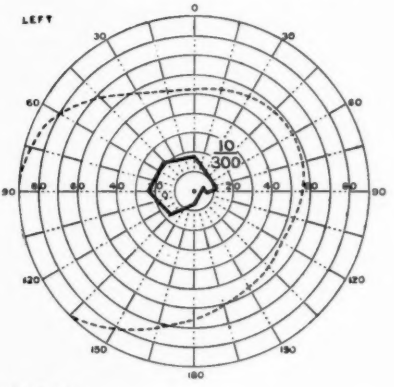
R and Q are interesting because, with distinctly visible lesions of definite vessel groups, the sectoral loss does not correspond. In R the sectoral loss involves nearly



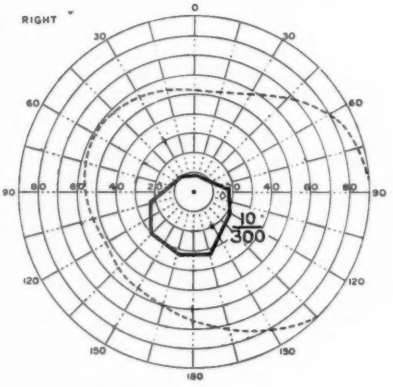
15.3.24. V $\frac{6}{6}$ (3)



15.3.24. V $\frac{6}{6}$ Blind spot $\frac{10}{1000}$

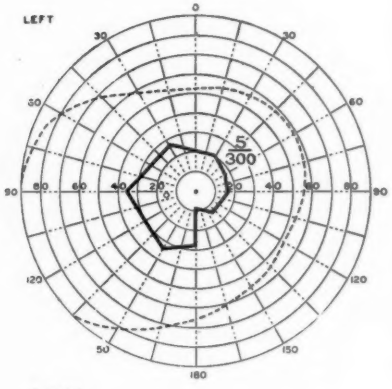


13.12.24.



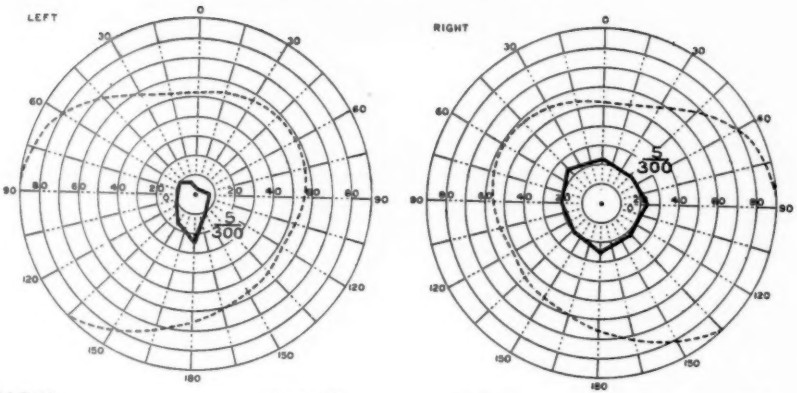
13.12.24.

CHART M.



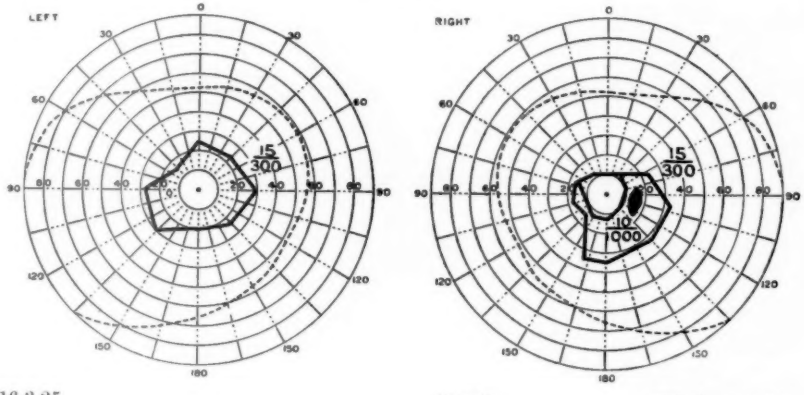
1.2.24.

CHART N.

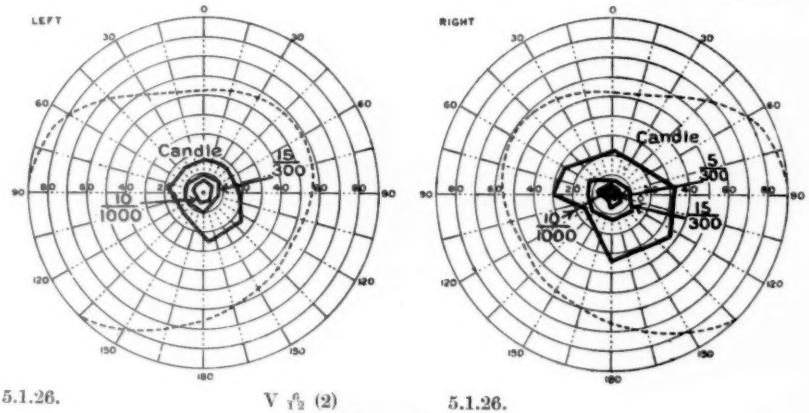


11.7.25. V $\frac{6}{12}$ (4) 11.7.25. V $\frac{6}{6}$

CHART O.

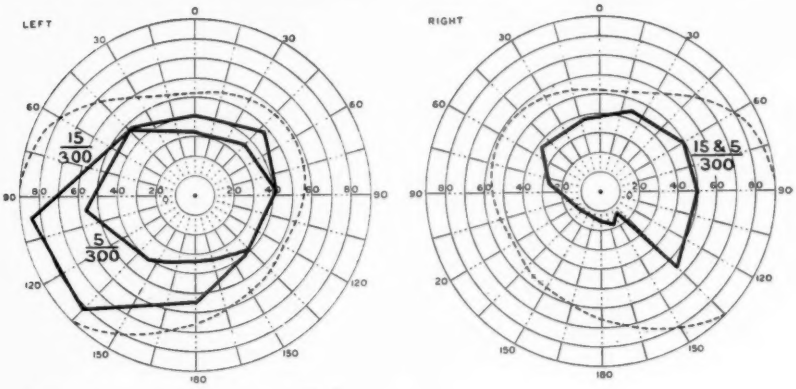


16.3.25. 16.3.25. Blind spot $\frac{20}{10\,0\,0}$



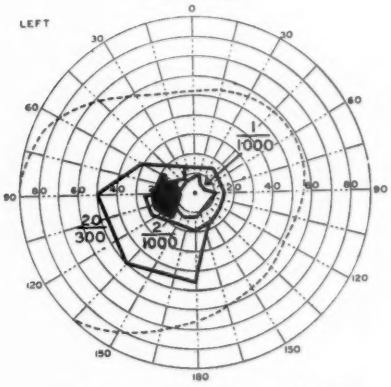
5.1.26. V $\frac{6}{12}$ (2) 5.1.26.

CHART P.



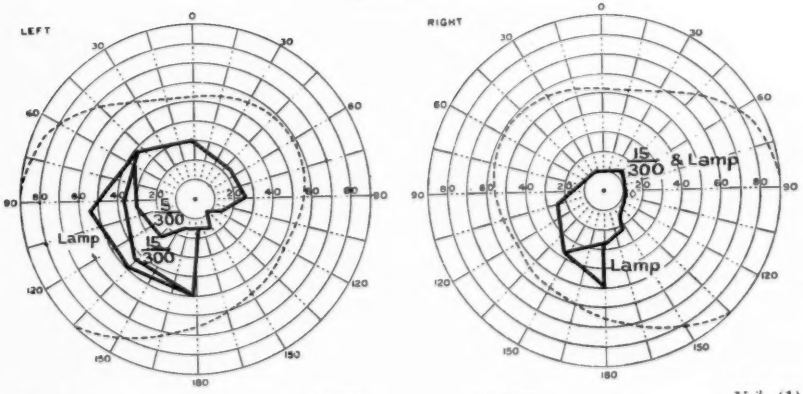
9.11.25. $V\frac{6}{18}$

CHART Q.



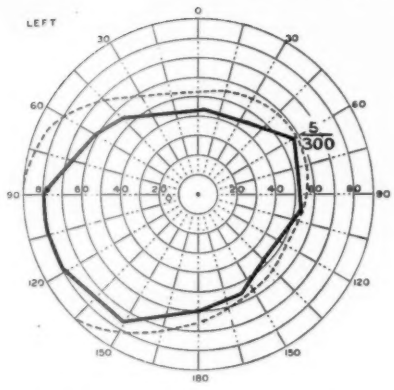
11.5.25. $V\frac{6}{6}$ (4)

CHART R.

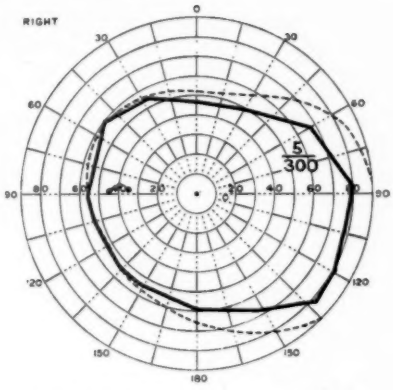


14.1.26. $V\frac{6}{18}$ (2) 14.1.26 $V\frac{3}{36}$ (1)

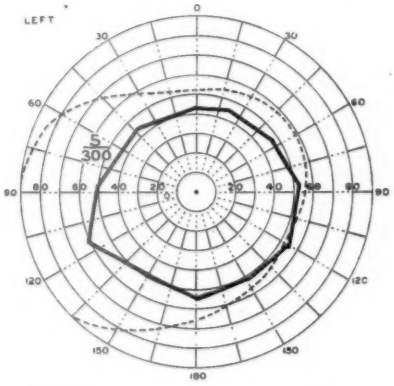
CHART S.



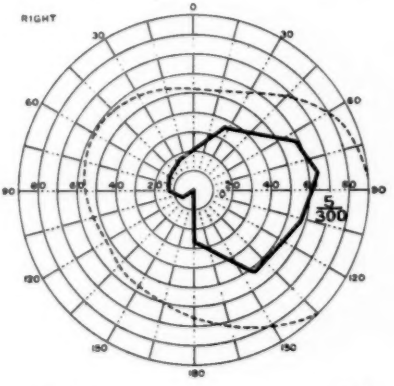
22.6.23. V $\frac{6}{6}$



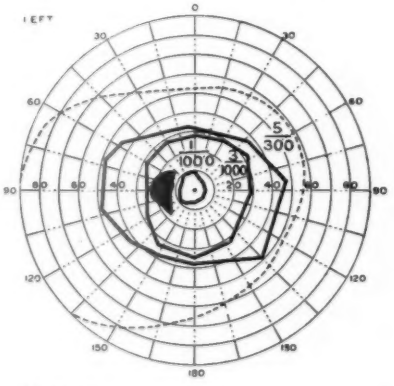
22.6.23. V $\frac{6}{5}$ (3)

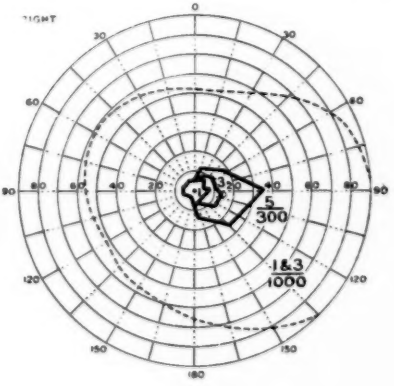


10.3.25. V $\frac{6}{18}$ (2)



10.3.25. V $\frac{6}{6}$



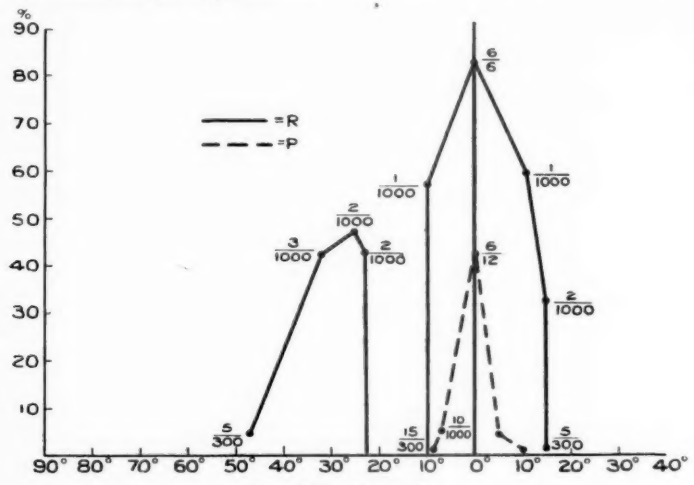


17.11.25.

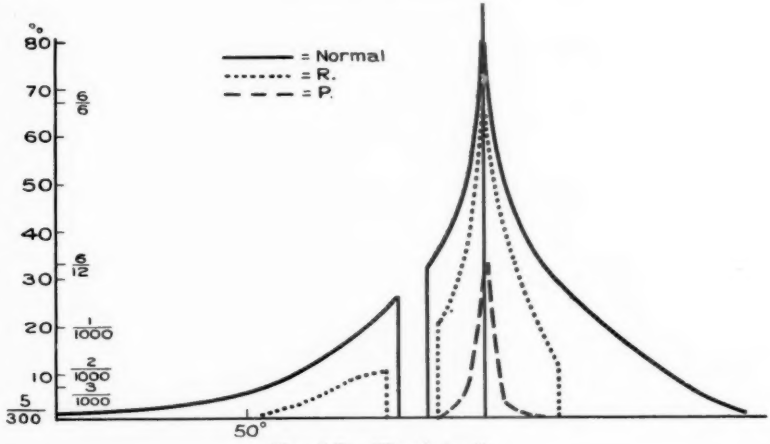
CHART T.

three quarters of the field, yet the obvious lesion affects the inferior temporal vessels; in Q (right eye) the inferior arteries are hardly visible, yet it is the inferior and not the superior half of the field that shows greater loss.

S shows sectoral loss very clearly. Here the superior arteries were the more narrowed in both eyes, so that the sectoral loss in the left eye corresponds fairly well with the ophthalmoscopic appearances.



R and P.—Percentage.

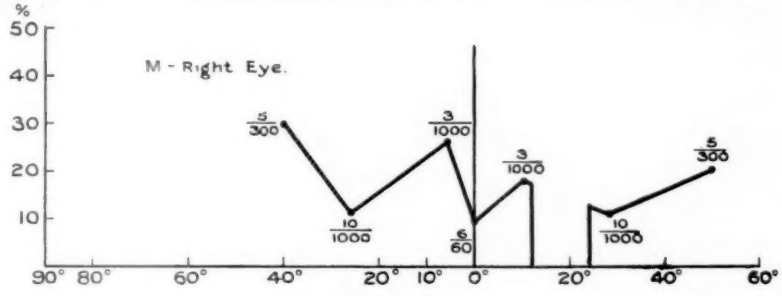


R and P.—Visual Acuity.

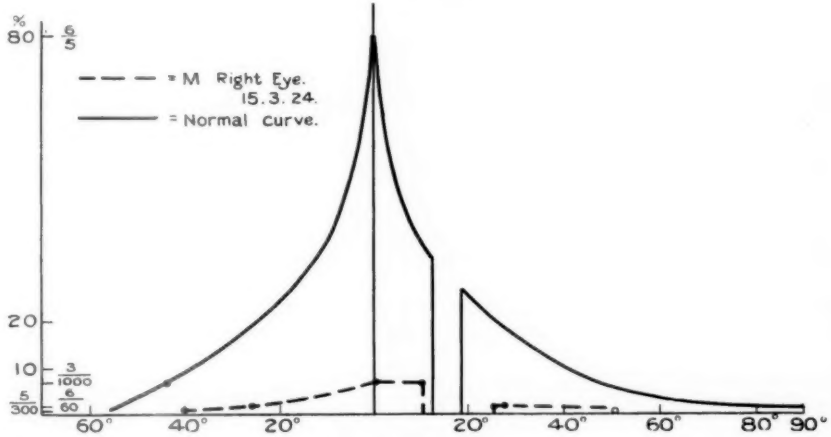
T is in a class somewhat by itself in its ophthalmoscopic appearances. When first seen the retinal veins in both eyes near the disc were of ordinary width, partly covered by white tissue, so that the column of blood appeared narrowed or had wholly disappeared. The arteries on the left disc had a sheath of fibrous tissue. Notwithstanding the very different appearances, the effect on the fields was the same as in the other cases. When first seen the fields were only slightly and concentrically

diminished. In twenty-one months the concentric diminution was much greater, and the right had also lost nearly the whole of the nasal half of the field. After eight months both showed further loss, each keeping to its own type. After four years of observation glaucoma occurred in the right eye, which was relieved by a trephining, though the latter has not prevented a further diminution in the field. It must be assumed that the further diminution after operation is due to the effects of atheroma, as tension was fully relieved by the operation.

Graphs of P and R in this group show concentric diminution very clearly, especially in P. On the other hand, M gives the exceptional case of unusual loss



M.—Percentage.



M.—Visual Acuity.

of vision in the central portion of the field; while the periphery is fairly well retained. R shows the steep fall in acuity which results where two or more field outlines coincide at any part, suggesting a precipice in a mountain range or a cliff on the sea shore.

The percentage graphs of this group emphasize the steepness with which the acuity falls in the periphery of the field in the generally contracted cases where the central vision is good; on the other hand, where central vision is much lowered, these graphs may show striking irregularities, as in M.

In attempting to arrange these cases in a series according to severity, it is not suggested that the history of any one case is thereby reconstructed; on the contrary,

a detailed consideration of the cases reported here suggests the variability of different cases as regards the relation of the fields, the fundus appearances, the blood-pressure, and the time factor. This variability is well shown by the tables giving the variations in the fields in relation to time and by the blood-pressures given in the list of cases.

Nevertheless, of the cases observed over a period, L, P and T do show concentric alterations; in L so far an increase, in P and T a decrease. In the right eye of T the concentric diminution has been accompanied by a sectoral loss.

No case in the series shows a sectoral loss without concentric diminution of the rest of the field; those cases observed over a period have all shown concentric diminution; while the cases considered as a series emphasize the same point—that concentric diminution of the field is the most constant accompaniment of atheroma of the retinal vessels. This does not deny the possibility of a damage limited to one sector of the field; it only affirms that this is at least rare.

General clinical experience shows that atheroma in the retinal vessels and atheroma in other parts of the body do not necessarily accompany each other. One must depend upon the increase of blood-pressure as the principal method by which the alterations in the blood-vessels of the whole body are estimated; its increase may be considered as due to the summation of the narrowing and rigidity of the small vessels. While the blood-pressure gives a general view of the whole picture, the details of this vary greatly in the amount of change present. But as time goes on more areas are involved and the intensity increases. The eye conditions, as revealed by the fields and fundus appearances, fall in with these conditions, both as part of the body and as in the details of the affection of the vessels.

Next must be considered the relation between the fields and the fundus conditions. Although the cases are arranged as far as possible in order of diminution in the fields, yet cases as far down in the list as H and T showed the same fundus appearances as A, B and C, i.e., cutting of the veins without any alteration in the size of the arteries or the brightness of their reflex. These slight alterations hardly account for the loss in the fields.

Two explanations suggest themselves, either there are greater alterations in the lumen of these arteries than would be expected from their external appearance, or the field alterations are secondary to changes in the main retinal artery. Probably both act simultaneously in some cases. The fairly concentric diminution in the fields of these cases does suggest a centrally situated cause rather than an atheroma fairly equally distributed over all its branches, for general considerations as to its irregular distribution in other parts of the body rule out the probability of this occurrence. Sectoral losses, on the other hand, are what would be expected from affections of particular branches of the retinal artery. Yet the fundus appearances do not always entirely agree with the fields. Mr. Foster Moore has shown quite clearly that in some cases alterations in the appearance of an artery are accompanied by a sectoral loss in the field, but case Q (right eye) shows that though a sector may be lost its corresponding arteries may appear normal, while the arteries corresponding with a fairly normal portion show marked narrowing, and F (right eye) shows no sectoral loss corresponding with a marked narrowing of the superior arteries. So that neither in general nor in sectoral contraction can we deduce from the ophthalmoscopic appearance what the visual field will be, or vice versa, except in a very general way.

In several of the cases there is distinct enlargement of the blind spot. If it be assumed that the central artery is affected about the level of the origin of the branches supplying the nerve head, this would explain the enlargement. If the atheroma were distal to these branches, the blind spot would not be affected. Since the cases with enlarged blind spot agree generally with those not so affected—and in the former atheroma of the central artery must be assumed—an additional reason is found for assuming that the general contraction of the fields is mainly due to an affection of the central artery.

ALTERATIONS IN FIELDS.

Some evidence as to this has been obtained. Using the method of an average of eight meridia, the average from the fixation point in these alterations is as follows:—

First Group.

F.—Two observations, six weeks interval.

			January 23, 1925	March 3, 1925
Object $\frac{5}{60}$	...	Right eye ...	56	51
,,	...	Left eye ...	46	58

Second Group.

J.—Duration of observation, thirteen months.

		Initial	3 months	3 months	3 months	4 months
Object $\frac{5}{60}$ ...	Right eye ...	64	37	51	48	41

Third Group.

			Initial	8½ months		
L.—Object $\frac{5}{60}$ ...		...	26	48		
				9 months		
M. ,, $\frac{5}{60}$ ...	Right eye ...		43	$\frac{10}{360}$ ... 20		
,, ...	Left eye ...		50	,, ... 13		
				3½ months	1 month	
P. ,, $\frac{15}{60}$ ...	Right eye ...		25	24	9	
	Left eye ...		24	33	11	
				21 months	6 months	2 months
T. ,, $\frac{5}{60}$ ...	Right eye ...		61	30	22	12
	Left eye ...		57	49	54	42

The general tendency to decrease in the fields is clearly shown, yet there are also increases too great to be regarded as errors of observation on the part of the patient, e.g., F, left eye. Case J, in the course of deterioration, showed marked fluctuations. No relation between these local alterations and the blood-pressure could be established.

SUMMARY.

These cases may thus be summarized. In all there is concentric limitation of the visual fields. In most there is a general loss of acuity over the whole field, the fixation point being generally least affected. In the more advanced cases the region of total loss tends to be more irregular and the margin of the remaining field to be abrupt, i.e., the periphery coincides with two or more sizes of test objects; in some cases a 4-volt lamp is not seen at the periphery. The sectoral nature of the losses in some severe cases makes it almost certain that this is due to a blocking of one or more branches of the retinal artery; on the other hand, the general distribution in extent and intensity may be explained by an affection of the central artery. Although some of the cases show that a very high degree of concentric diminution may occur, it is interesting to note that in none of the cases had the patients the difficulty in finding their way about that occurs in glaucoma patients with small fields.

As the retinal artery is essentially a branch of a cerebral artery, and as no branches of the cerebral arteries have anastomoses, it is interesting to speculate upon the bearing of loss of function in the area of the retinal artery when affected by atheroma with a similar condition in the finer branches of the cerebral arteries. In the case of the retinal artery branches there may be little to be seen in the retina if there are no hæmorrhages or white spots, which have been excluded in the cases detailed; yet a distinct loss of function occurs over the whole field. May not a similar change occur in the finest branches of the brain?—not to be detected by decided loss of function such as occurs in thrombosis or hæmorrhage, yet accounting for the subtle alterations in

memory, desire and ability for action, loss of judgment, the incapacity for prolonged mental exertion, slowed reaction, which are so characteristic of many people who suffer from atheroma, yet who have not been overtaken by its graver consequences.

REFERENCES.

[1] Foster Moore, *Quart. Journ. Med.*, 1916, x, p. 29. [2] Traquair, H. M., *Brit. Journ. of Ophthal.*, 1924, p. 55. [3] Pickard, R., *Brit. Med. Journ.*, 1923, vol. ii, p. 129.

Case Summaries.

A.—Female, aged 65.

Right eye, vision $\frac{6}{5}$ (6). Media normal. Fundus—veins slightly cut and slightly dilated.

Left eye, vision $\frac{6}{6}$ (4). Media normal. Fundus—veins slightly full, not cut.

B.—Male, aged 71.

June 25, 1925. For a few days dimness in the lower half of the left field.

Right eye, vision $\frac{6}{5}$ (5). Media—slight lens haze. Fundus—slight cutting of veins.

Left eye, vision $\frac{6}{18}$. Slight lens haze. Fundus—large and small hæmorrhages with white, fluffy patches in the superior temporal area.

Blood-pressure, systolic, 210.

August 24, 1925. Right eye, vision $\frac{6}{5}$ (4). Left eye, vision $\frac{1}{60}$.

October 14, 1925. Right eye, vision $\frac{6}{5}$ (5). Fundus unchanged. Left eye, vision $\frac{1}{60}$. Fundus—large hæmorrhages near macula.

C.—Male, aged 59.

August 20, 1925. Noticed a defect in the sight of the right eye, following a few days of whirling sensation. Blood-pressure has varied from 200 to 190, urine 1010, no albumin. Heart—second sound accentuated over aortic area.

Right eye, vision $< \frac{1}{60}$. Media normal. Fundus—typical thrombosis of retinal vein, not many hæmorrhages in the lower quadrant.

Left eye, vision $\frac{6}{5}$. Media normal. Fundus—arteries not narrowed—veins slightly cut.

D.—Female, aged 67.

August 27, 1925. Came for weakness of sight.

Right eye, vision $\frac{6}{5}$ (2). Media—two small vacuoles in lens. Fundus—veins not cut. Arteries generally slightly narrowed, superior nasal artery shows a local narrowing near the disc.

Left eye, vision $\frac{6}{5}$ (4). Media—a faint spicule in periphery of lens. Fundus—one vein cut, the other veins are in front of the arteries, which are slightly narrowed.

E.—Male, aged 69.

April 3, 1924. Six weeks ago reddish spots before the eyes, which have continued. To-day pain behind the eyes.

Right eye, vision $\frac{6}{5}$ (5). Media normal. Fundus—veins slightly irregular in calibre, vessels otherwise normal.

Left eye, vision $\frac{6}{5}$ (5). Media—a few spicules in the lens up and out, not in pupillary area. Fundus—veins full, cut by tortuous arteries, superior temporal area is hazy near the disc. No hæmorrhages or spots.

Blood-pressure, systolic, 152.

F.—Female, aged 57.

End of December, 1924. Loss of vision in right eye for half hour, which recurred every day at 11 a.m. No pain, no headache.

January 23, 1925. *Right eye*, vision $\frac{6}{24}$ (4). Media normal. Fundus—retinal veins cut. Superior branch of the retinal artery of normal width. At the edge of the disc it divides into two very small vessels—the superior nasal and temporal branches.

Left eye, vision $\frac{6}{12}$ (2). Media normal. Fundus—retinal veins cut by arteries. The two temporal branches of the retinal artery show marked narrowing.

January 27, 1925. No loss of sight in right eye during past week.

Urine 1004, no albumin. Blood-pressure, systolic, 200.

February 3, 1925. Patient has noticed a cloudiness in the outer corner of the right field.

February 10, 1925. Headache better. No cloud noticed in right field.

G.—Male, aged 67.

November 23, 1925. For two years a black speck apparently floating 10 in. from the left eye. Comes because of difficulty with fine work.

Right eye, vision $\frac{6}{6}$ (5). Media normal. Fundus—surface of disc raised 1 D, disc cup shallow. Superior temporal vein cut; arteries slightly narrowed, otherwise fundus normal.

Left eye, vision $\frac{6}{6}$ (4). Media normal. Fundus—inferior temporal vein cut; arteries slightly narrowed; no hæmorrhages or spots.

H.—Male, aged 38.

Right eye, vision $\frac{6}{4}$ 5 (3). Media normal. Fundus—veins tortuous, some cut. Fundus otherwise normal.

Left eye. Iritis.

Blood-pressure, systolic, 160.

I.—Female, aged 64.

March 26, 1925. Diplopia for six weeks.

Right eye, vision $\frac{6}{6}$ (5). Media—a few very fine dots and one small vacuole in lens. Fundus—veins rather full, slight cut, otherwise normal.

Left eye, vision $\frac{6}{6}$ (2). Media—a few fine dots in lens. Fundus as in right eye.

J.—Male, aged 55.

November 11, 1925. Blur on right side of left field for three weeks, almost sudden onset, no pain.

Right eye, vision $\frac{6}{4}$ (5). Media normal. Fundus—veins cut, otherwise normal.

Left eye, vision $\frac{2}{60}$. Media normal. Fundus—large hæmorrhages and white fluffy-edged patches in area of superior temporal vessels.

January 3, 1925. Urine—slight cloud of albumin. Blood-pressure, systolic, 250.

May 29, 1925. Blood-pressure, systolic 260. Right superior nasal artery narrowed.

January 1, 1926. *Right eye*, vision $\frac{6}{6}$. *Left eye*, vision $\frac{6}{24}$.

February 5, 1926. *Right eye*, vision $\frac{6}{6}$. *Left eye*, vision $\frac{6}{18}$.

K.—Female, aged 69 years.

March 3, 1925. Came for foreign body under upper lid.

Right eye, vision $\frac{6}{6}$ (5). Media normal. Fundus—veins full and tortuous, slight cut by arteries, otherwise normal.

Left eye, vision $\frac{6}{6}$ (4). Media normal. Fundus—same as right eye.

L.—Female, aged 50.

October 16, 1923. The sight of left eye went suddenly on October 8, 1923, no pain.

Right eye, vision $\frac{6}{24}$ (3). Media normal. Fundus—arteries narrowed, veins cut. A few whitish spots around disc and three near the macula.

Left eye, vision h.m. Many moving opacities in the vitreous. Fundus—reflex only, no details.

October 19, 1923. Urine—no albumin, no sugar, sp. gr. 1006.

March 13, 1924. Blood-pressure, systolic 210.

May 19, 1924. Urine 1010, no albumin.

November 24, 1924. *Right eye*, vision $\frac{6}{24}$ (1). Fundus as before.

Left eye, vision $\frac{1}{36}$. Fundus—no details because of vitreous opacities.

M.—Male, aged 67.

March 15, 1924. Not an observant man, no definite history of loss of sight in the right eye. Has sciatica.

Right eye, vision $\frac{6}{60}$. Media normal. Fundus—arteries all narrowed, with bright reflex, cutting the veins at crossings. Disc red, surface + 2 D above retina. No hæmorrhages or white spots.

Left eye, vision $\frac{6}{6}$ (3). Media normal. Fundus—arteries slightly narrowed, veins cut. No hæmorrhages or spots.

March 17, 1924. Urine 1020, distinct cloud of albumin. Blood-pressure, systolic 190.

December 13, 1924. *Right eye*, vision $\frac{1}{60}$. Fundus—arteries very tortuous, veins somewhat obscured, some small hæmorrhages.

Left eye, vision $\frac{6}{36}$ (1). Fundus much as the right, a fairly large hæmorrhage above the y.s.

N.—Male, aged 76.

January 11, 1924. A black spot before the eye, which disappears if the hand is stretched towards it.

February 1, 1924. *Right eye*, vision $\frac{6}{5}$ (3). Lens normal. Vitreous—a clump of freely moving vitreous opacities. Fundus—disc cup 60 per cent., otherwise normal.

Left eye, vision $\frac{6}{5}$ (3). Media normal. Fundus—arteries and veins narrowed. Some arteries have a white sheath, one is replaced by a white line. The inferior temporal artery cannot be traced beyond one disc diameter from the disc. No spots or hæmorrhages. Probably the black spot was a positive scotoma—I was told that it afterwards disappeared.

O.—Male, aged 78.

July 11, 1925. History of hæmorrhages in the eyes two years ago. Sight is getting worse, has occasional mists.

Right eye, vision $\frac{6}{9}$. Media normal. Fundus—arteries much contracted, veins normal. Only two small white spots to be seen, no hæmorrhages. Disc cup 15 per cent.

Left eye, vision $\frac{6}{12}$ (4). Media normal. Fundus—50 per cent. cup, 2D deep. Arteries narrow, veins slightly tortuous, normal size. No spots or hæmorrhages.

P.—Female, aged 52.

November 11, 1924. Difficulty with near vision, headaches.

Right eye, vision $\frac{6}{9}$ (4). *Left eye*, vision $\frac{6}{9}$ (3). Mediæ normal. Fundi—both discs red, veins slightly cut.

January 20, 1925. In both eyes fine yellow spots, not abundant, near disc and macula.

February 3, 1925. Urine 1008, faint cloud of albumin.

February 17, 1925. Blood-pressure, systolic, 140.

March 17, 1925. Blood-pressure, systolic, 170.

October 27, 1925. Blood-pressure, systolic, 175.

January 5, 1926. Blood-pressure, systolic, 160. In both fundi veins are cut, the arteries decidedly narrowed on the discs.

Q.—Female, aged 75.

November 9, 1925. Sees "moving things" when the eyes are shut and a film when they are open.

Right eye, vision $\frac{6}{18}$ (3). Media—lens has general haze and a distinct opacity below. Fundus—veins tortuous, not dilated. The inferior branch of the retinal artery is of normal width, it divides into two minute arteries which can hardly be followed—the inferior nasal and temporal arteries. Superior arteries normal.

Left eye, vision $\frac{6}{9}$ (3). Media—lens has a few minute spicules below. Fundus—veins not full, slightly tortuous, arteries normal. Blood-pressure, systolic, 155.

The cataract prevents any deductions from detailed perimetry; the case is introduced to show the want of correspondence between the right retinal arteries and the field.

R.—Female, aged 66.

May 11, 1925. Much headache after reading, no history of loss of sight.

Right eye, vision $\frac{6}{9}$ (4). Media—very minute dots in the lens. Fundus normal.

Left eye, vision $\frac{6}{9}$ (4). Media—fine opacities in periphery of lens below. Fundus—some veins cut, not dilated. Arteries not narrowed, no bright reflex. A white plate lying over inferior temporal vessels $\frac{1}{2}$ disc diameter from disc and $\frac{1}{2}$ disc diameter in width. Calibre of artery and vein equal on either side of the plate. Blood-pressure, systolic, 160.

S.—Female, aged 65.

December 20, 1921. Sight of right eye getting worse for a year.

Right eye, vision $\frac{6}{60}$, the letters being seen momentarily but not read. Media normal. Fundus—disc white, arteries and veins narrowed, especially at the junction of the branches on the disc. The veins very tortuous on the disc. Field not charted by hand scotometer; the upper inner portion is lost.

Left eye, vision $\frac{6}{9}$ (4). Media normal. Fundus—disc brick red, slightly swollen arteries have a bright reflex.

January 14, 1926. Says the right eye got better, but has been getting worse for three or four months.

Right eye, vision $\frac{1}{36}$ (1). Fundus unaltered.

Left eye, vision $\frac{6}{18}$ (2). Fundus—inferior arteries normal, their accompanying veins slightly swollen; superior arteries narrow with bright reflex. Blood-pressure, systolic, 240.

T.—Female, aged 62.

January 28, 1921. Eyes and head have ached for two months.

Right eye, vision $\frac{6}{9}$.

Left eye, vision $\frac{6}{12}$. Media normal. Fundi—in both the veins on and near the disc have the blood-column partly or wholly obscured by white tissue. The arteries of the left eye on disc have white sheaths.

February 4, 1921. Urine 1016, no albumin.

February 18, 1921. Much headache.

June 24, 1921. Had cough and hæmoptysis, is now giddy and has headache.

August 5, 1921. *Right eye*, vision $\frac{6}{9}$ (2). *Left eye*, vision $\frac{6}{12}$.

May 16, 1923. *Right eye*, vision $\frac{6}{9}$ (3). *Left eye*, vision $\frac{6}{9}$, (4). Nearly all retinal vessels have fibrous sheaths on and near discs.

October 31, 1924. Sight of right eye occasionally goes, but returns. Rainbow haloes night and morning.

Right eye, vision $\frac{6}{9}$, disc cup, 3 D. deep. Vessels as before. T. (Sch.) (15g)65.

Left eye, vision $\frac{6}{9}$. Vessels as before. (7·5g)30.

November 4, 1924. T. *Right eye*, (5·5g), 28. *Left eye*, 13.

April 28, 1925. T. *Right eye*, 50. *Left eye*, 23.

Blood-pressure, systolic, 175.

May 14, 1925. *R. trephining with iridectomy.* Vitreous presented, but did not escape.

June 9, 1925. *Right eye*, vision $\frac{6}{9}$. T. 8. *Left eye*, vision $\frac{6}{12}$. T. 21.

September 1, 1925. *Right eye*, veins on inner sides diminished, on outer side slightly enlarged, sheathed to $\frac{1}{3}$ disc diameter from disc. *Left eye*, veins decidedly swollen to edge of disc, diminished on disc, no sheath visible except slightly on one vein. Sheaths on some of the arteries, which are narrowed and obscured in parts on the disc.

October 20, 1925. *Right eye*, T. 13. Some iritis. *Left eye*, T. 30.

February 9, 1926. *Right eye*, vision $\frac{6}{9}$ (3). T. 13. *Left eye*, vision $\frac{6}{9}$. T. 31.

Note.—In the left eye the disc cup decreased from 30 per cent. to 15 per cent. in fourteen months, the first case in which I have been able to measure this, though it probably happens frequently, for many cases with retinal atheroma show small disc cups.

Discussion.—Mr. R. FOSTER MOORE said he had not realized that sectoral loss was so rare as had been made clear by Mr. Pickard. There might be obvious changes in the branches of the artery with a sectoral loss which did not correspond with the affected vessel. A tributary of the retinal vein might become obstructed without a corresponding sectoral loss of vision, but such sectoral loss afterwards developed in a fair number of cases; it was, of course, different from the narrowing of an artery. He judged that a general concentric loss of field was usually due to narrowing of the central retinal artery itself. It had struck him sometimes, in taking fields for homonymous hemianopia, that the seeing half was reduced in a concentric way, and he did not see why that should be.

He thought the loss of energy and of memory must be very distressing to these patients, they were often so insistent upon it; it was a marked feature of cases which showed evidence of sclerosis of the retinal arteries and presumably of the cerebral arteries also. In some of these cases there might be a sectoral defect due to cortical involvement. If there was no loss from peripheral vascular change it would be easy to identify such loss due to cortical involvement, but if there was loss of field due to peripheral vascular disease in the retina it might be difficult to identify a defect which was in fact due to vascular disease involving the visual cortex.

Mr. ERNEST CLARKE said he thought it would be of even more interest if the diastolic pressures could be stated also. Halls-Dally and others had pointed out that the systolic pressure gave but little information. In some cases of apparently high blood-pressure, as in aortic regurgitation, the diastolic pressure was very low, and Mr. Pickard, in the light of the diastolic pressures, would probably find that all his cases had a low pressure, that the blood did not reach the periphery owing to lacking a sustained "push," and because of the hardness of the arteries offering opposition. Mr. Pickard's idea that the eye condition might throw some light on that of the brain was very apt.

Dr. GORDON HOLMES said that for anyone who had devoted a considerable amount of time to testing any form of sensation by graded stimuli, this paper raised a large number of interesting points.

The cases reported by Mr. Pickard did not belong to a homogeneous group. It might be, as the author himself admitted, that local lesions of the central artery were responsible for some of the defects, or, as Mr. Foster Moore had pointed out, that the lesions were more central in the tracts, radiations, or in the cortex. For that reason it was important that in every case showing defects the field of vision should be taken under the same conditions in both eyes.

He (the speaker) thought there was another explanation of some of the observations so well reported by Mr. Pickard, namely, that there was an important psychological factor present. For five or six years he (Dr. Holmes) had worked on delicate changes in sensation, and since then he had been engaged in similar or allied studies. His experience was that in certain cases it was difficult to employ graded stimuli. There could be no doubt that the application of graded stimuli in persons over 55 or 60 was difficult, because in any prolonged test the attention tended to fail. In the cases under consideration there might be a definite perceptual defect, too, due to central, rather than peripheral, causes. Therefore his suggestion was that in some of these cases, but not in all, the narrowed fields of vision shown on the charts were due to either a pathological or, momentarily, a psychological failure of attention, or to a general diminution of perceptual acuity, possibly associated with a cerebral arterio-sclerosis. That the psychological factor was present seemed probable from certain remarks Mr. Pickard had made, as even though the field was reduced to a very small central area, some of the patients felt no discomfort from it. Some of the charts shown also indicated a great variability in the extent of the field, greater than would be expected if the cause were a structural or anatomical one, such as arterio-sclerosis of vessels. It was not his suggestion that all the cases Mr. Pickard had dealt with could be explained in the way he (the speaker) had suggested, but he thought it was a factor leading to the production of such fields as were projected on to the screen, particularly the cases in which a large number of observations were made in succession on the same day, and were not controlled by similar tests on other days.

He did not wholly agree with the title of the paper, because in many of the cases Mr. Pickard admitted there was no visible change in the retinal vessels. He (Dr. Holmes) believed that even when vessels had normal walls a sufficiently high blood-pressure might lead to a definite compression or distortion of retinal veins.

Mr. PICKARD (in reply) said that, in regard to the diminution in the seeing half in cases of hemianopia, he (the speaker) had found the work he had been doing most useful in reminding him that there were other conditions, besides glaucoma and atrophy of the optic nerve, that caused diminution of fields. When an eye showed any atheromatous changes in the retinal vessels, he always tried to make a rough clinical estimate of their influence on the fields. This was of use in a recent case of advanced glaucoma in one eye, with a much diminished field in the other and atheromatous changes, but with no rise in tension, and no cupping of the disc. He felt justified in attributing the changes to the atheroma. Seeing that so many changes of hemianopia occurred in elderly people, it would be natural that a proportion of these should have diminished fields due to atheroma of retinal vessels.

He regretted that only in one or two of the cases was the diastolic pressure taken; perhaps in the future he would be able to rectify this omission.

With regard to Dr. Gordon Holmes' remark that this was not a homogeneous group, he was able to state all the cases showed signs of atheroma in the retina. The notes showed that in each case there was a change which justified the term "atheroma of retinal vessels." If the condition had been due to some central cause, one would have expected something of the nature of hemianopia in the two eyes. That he had been very careful to investigate, and he thought examination of the charts would show that it was not so.

He fully agreed with what Dr. Gordon Holmes said as to the importance of the psychological factor; he had carefully excluded cases in which he thought the people were not good observers or who seemed unable to stand the strain of the examinations. The time-reaction was very important, and he carefully scrutinized the patients while the tests were in progress. Many patients were hopeless from this point of view, because the best one could obtain was some approximation to accurate results. As to tiring patients, he could plead "not guilty!" as he took care that they had a good rest between making the tests. He had not made more than eight observations with any one test disc in the outer part of the field. One case (P) he watched particularly from the point of view of it being possibly an instance of hysterical contraction. He found that just where the retinal artery came up from the disc there was a distinct narrowing of it; it was narrower than further out. The trouble was in the "bottle-neck," and it was justifiable to assume that the pressure here had some effect on the general circulation. He had reasons for including that case among his series.

With regard to variability in the size of the fields, the patients were good witnesses, and surely relaxation of arteries in a particular area could occur. His experience when in general practice showed him that patients the subjects of increased blood-pressure varied considerably; why, therefore, should there not be alterations in the direction of improvement in the retinal fields?

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Section of Orthopædics.

President—A. S. Blundell Bankart, M.Ch.

The Physiology of Muscular Action.

PRESIDENT'S ADDRESS.

By A. S. Blundell Bankart, M.Ch.

It is not long since a well-known surgeon said that surgery was anatomy, pathology and common sense, while as for orthopædic surgery, it was nothing but anatomy and common sense. This is a common misconception of orthopædic surgery as a sort of mechanical craft. The *Proceedings* of this Section alone would convince anyone of the wealth of pathological material with which we have to deal. But orthopædic surgery is more than that. The ultimate aim of orthopædic treatment is *restoration of function*, and those who profess to deal with disorders of bodily function must have some knowledge of the normal functions of the body, that is, physiology.

Ten years ago Sherrington remarked that "the publications of zoologists and clinicians do not commonly meet quickly." It is rather humiliating to discover that some cherished belief, some generally accepted theory and perhaps the treatment based upon it, is about twenty years behind the known facts of physiology. So I thought that I might use this occasion to direct your attention to some bearings of physiology on orthopædic surgery, rather with a view to stimulating thought and discussion, than with any idea of presenting new facts. And, as so much of our work is concerned with the action of muscles, and time is short, I will confine my remarks to this important part of the subject—the activities of muscle.

Some years ago I drew attention to the significance of Sherrington's work on the postural activity of muscle, work which has not only thrown new light on the nature of posture and the disorders of posture, but has compelled us to revise entirely our ideas concerning the action of muscles generally.

It is now known that the skeletal muscles exhibit two kinds of activity. The one is phasic—quick and transient and concerned with the execution of movement; the other is tonic—relatively slow and prolonged, and concerned with the maintenance of posture. These two kinds of muscular activity are physiologically quite distinct. They differ in their effects, in their metabolism, in their nervous mechanisms, and recently it has been said that they are anatomically separate. But of this I shall have more to say presently.

Muscle is a specialized substance which has the property of altering its shape in response to a nervous impulse. This alteration in shape, which gives rise to movement, is due to a change of surface tension, brought about by electro-chemical means, upon the surface of the muscle-fibres. It should be noted that a muscle-fibre undergoes no change in volume; it merely becomes more spherical or less spherical, as the case may be. Both contraction and relaxation of muscle are thus active processes. The change is accompanied by a great expenditure of chemical energy, by the production of heat, and by the consumption of oxygen and output of carbonic acid. If unduly prolonged or frequently repeated, this kind of activity becomes rapidly fatigued and the muscle becomes incapable of further action until it has rested.

Except that smooth or unstriated muscle has a certain power of automatic action, the only natural stimulus of muscle is a nervous impulse. The response to a single

nervous impulse is a single twitch. Voluntary contraction is a tetanus, that is, a summation of twitches, brought about by a rapid succession of impulses down the nerve-fibre, at the rate of about fifty per second.

It was shown by Keith Lucas that the propagated disturbance in a nerve-fibre is always of the same intensity, regardless of the strength of the stimulus. It follows, therefore, that the nervous impulses which reach muscle-fibres are always of the same strength. It is now known, too, that muscle contracts on the "all or none" principle, that is, if it contracts at all, it contracts for all it is worth. This used to be thought to be a peculiarity of heart-muscle, but it is now known to be true of all muscle.

There are, therefore, no degrees of contraction in normal muscle-fibres; there is no such thing as a strong contraction or a weak contraction, apart from the size of the muscle-fibres concerned. The absolute strength of a muscle is determined by the size and the number of its muscle-fibres. The different degrees of response that may be obtained on stimulation of a motor-nerve are due to the number of nerve-fibres, and therefore to the number of muscle-fibres, excited by different stimuli. A strong stimulus excites many or all of the nerve-fibres, and therefore brings into action many or all of the corresponding muscle-fibres, and the result is a strong contraction of the muscle; while a weak stimulus excites few nerve-fibres, and brings into action few muscle-fibres, and we get a weak contraction.

For a given muscle, therefore, the strength of a contraction is the direct expression of the number of nervous impulses sent into it. Much of what is commonly spoken of as muscular weakness has nothing whatever to do with the muscles, but is entirely a question of nervous energy.

I would add here that we speak loosely—perhaps conveniently—of the education or re-education of muscles. But, of course, you can no more educate a muscle than you can educate a liver or a bone. The only thing that you can educate is a reflex—that vital process which occurs exclusively in connexion with the terminations of a nerve-cell. It is not sufficiently recognized that the basis of so-called remedial gymnastics and re-education is neurology.

The muscles on one aspect of a joint are sometimes called the antagonists of those on the opposite aspect. This is an unfortunate choice of a word to express a mere anatomical fact. Muscles do not oppose one another, they co-operate. When movement takes place, the contraction of one group of muscles is accompanied by reciprocal elongation of the opposite group, and the nervous impulses which cause the latter to relax are the direct outcome of those which make the former contract. Even when muscles on both sides of a joint contract simultaneously, as in the fixing of a posture, this is not antagonism, but a concerted action. Paralysis of reciprocal innervation gives rise to a grave functional disorder which we call spastic paralysis. This, if you like, may be called antagonism.

Now, speaking still of movement in muscle-fibres, it is well known that the nature of the response differs in different kinds of muscle. Thus, the typical twitch in striated or skeletal muscle is a sudden, quick contraction which rapidly reaches its maximum and almost as rapidly falls away; while the contraction of smooth or unstriated muscle is relatively slow and prolonged, presenting a gradual rise and a still more gradual fall. What is the difference? Both kinds of fibre are subjected to a similar change of surface tension; why does one respond quickly, and the other slowly?

I introduce this question here because, as we shall see, it has an important bearing upon another question which has become prominent recently—namely, the question of the dual structure of muscle. Note that we are now considering the phenomenon of movement in two different kinds of muscle-fibre. It seems that the different rates of response to stimulation of striated and unstriated muscle

respectively, can only be due to the fact that one kind of fibre offers more, and the other less, resistance to the force which brings about its change of shape. In other words, it is a question of the internal resistance or viscosity of the cell substance. Now, viscosity is a physical property which can be made to change, and it is significant that in certain circumstances, for example, in veratrin poisoning and in the condition known as decerebrate rigidity, the contraction of striated muscle approximates in character to that of unstriated muscle.

The postural activity of muscle is concerned, not with the execution of movement, but with the prevention of movement, that is, the posturally acting muscle develops within it a state of tension or resistance to a force which is trying to stretch it, without itself necessarily undergoing any outward change.

The most remarkable features of this activity are: (1) the "lengthening" and "shortening" reactions by which the muscle adapts itself to different lengths while maintaining the same tension. It was this property which led Sherrington to apply the term "plastic tonus" to postural activity; (2) the fact that it entails hardly any appreciable increase of metabolism, so that it can be maintained almost indefinitely without exhibiting any signs of fatigue.

Now, this state of tension or resistance might be brought about by a change of surface tension of the muscle-fibres, similar to that which produces movement, by an isometric contraction of the muscle, in fact; and this actually is the means by which resistance is offered to a force greater than that which is developed in ordinary postures. But, as we have seen, this phasic activity of muscle is accompanied by a great expenditure of energy and by the rapid onset of fatigue, so that it cannot be maintained for long. On the other hand, the postural activity of muscle is maintained with hardly any perceptible increase of metabolism, and it is almost incapable of fatigue.

Clearly we are dealing here with quite a different mechanism. It has been likened to a rachet or catch mechanism, by which a state of tension may be maintained indefinitely without the expenditure of any energy. In the living cell such a condition can be attributed only to some change in the physical characters of the cell substance.

The viscosity of cell substance is known to vary significantly at different times in the life of the cell, and Bayliss showed that visible changes in viscosity may be brought about by disturbances such as are called stimuli. It is known that colloidal solutions in certain circumstances have the property of setting or clotting, like the setting of a solution of gelatine on cooling, and that they then offer a resistance to deforming forces many times greater than they could while in the fluid state. This is a physical reaction and reversible, and it has been suggested that the postural activity of muscle is a similar reaction controlled by its special nervous mechanism. So that, in the language of physical chemistry, the postural activity of muscle consists in a change from sol to gel, and herein lies the explanation of a state of tension or resistance developed without perceptible increase of metabolism and maintained without fatigue.

From the physiological point of view there appears to be no reason why these two functions, movement and posture—the one a change of surface tension, and the other a change in the molecular arrangement of the cell-substance—should be performed by different structures, by different parts of the muscle-fibres, as originally suggested by Bottazzi, or by actually different muscle-fibres, as recently claimed by Hunter. Indeed, in view of the close co-ordination that exists between movement and posture in higher animals, an anatomical separation would appear to be a positive disadvantage. Such a primitive arrangement obtains in some invertebrates in whom these functions are of the simplest order. But, in vertebrates, so far as can be made out, movement and posture are different reactions of the same muscle-fibres. Indeed, the more closely the question is studied, the more probable it appears that

postural activity is but a further degree of that viscosity or internal resistance which we have seen to be a variable quality in muscle-fibres performing movements.

It is necessary, therefore, to examine somewhat critically the evidence recently put forward by Hunter and Royle in support of their contention that the functions of movement and posture are performed by entirely different sets of muscle-fibres, the movement fibres being supplied by the ordinary spinal nerves, and the postural fibres by the sympathetic. An excellent review of the whole question by Walshe has just appeared in the last number of *Medical Science Abstracts and Reviews* [1], so I shall be very brief.

It has long been known that the skeletal muscles receive accessory, non-medullated, or sympathetic nerve-fibres in addition to the ordinary spinal nerves. These consist of fine fibres connected on the one hand with the perivascular sympathetic nerve plexuses and ending in the muscle-fibres independently of the motor end-plates.

The presence of these fibres seems to have caused some surprise, and there has been much speculation as to the functions which they could possibly serve. But there are two points which I have not found mentioned in any of these discussions. First, are not all functioning tissues supplied by the sympathetic? Function is accompanied by an increased blood-supply which is assured by reflex vaso-dilatation through the sympathetic. Secondly, in warm-blooded animals the skeletal muscles are the chief source of heat. Heat is conserved by muscular activity and peripheral vaso-constriction, while heat loss is promoted by muscular relaxation, peripheral vaso-dilatation and sweating. These are nicely co-ordinated sympathetic reactions, and it is therefore not surprising to find that sympathetic nerve-fibres go to the skeletal muscles. It should also be noted that it is phasic, not tonic, muscular contraction that gives rise to heat.

Hunter's work started from the observation of Kulchitsky that "the medullated and non-medullated fibres never end in the same muscle-fibre." This is at best a negative observation and contrary to the findings of Boeke, Agduhr, and others. In fact, Hunter himself said that the question must be decided on the experimental evidence.

For a criticism of the experimental and clinical evidence in detail I shall refer you to Walshe's excellent paper [1]. Here I shall content myself with quoting his main conclusion that "the experiments and the clinical cases are inconclusive, and the descriptions thereof contain details not explicable on any theory of sympathetic function." Others working on the same lines have failed to obtain results approaching those claimed by Hunter and Royle. In short, it may be said that the whole weight of evidence—histological, experimental, and clinical—is against the hypothesis of a specific innervation of the tonic or postural activity of the skeletal muscles by the sympathetic; against the separation of muscular tone into two elements—"contractile" tone and plastic tone; and against the conception of a dual structure of muscle.

To this I will briefly add my own small experience on the clinical side. I have done the operation of sympathetic ramisectomy ten times (in seven patients); lumbar ramisectomy nine times, and cervical ramisectomy once. All but one were typical cases of spastic paralysis exhibiting the plastic tonus described by Sherrington. The odd case was one of paraplegia in flexion with pronounced flexor spasms, and it is interesting to note that the result, such as it was, of the operation in this case was at least as well marked as in any other case that I have seen. In four cases no appreciable effect on the muscular condition was noted after operation. In six there appeared to be a definite, though slight, diminution of the muscular spasm. It has seemed to me about comparable to the amount of relaxation that might be expected from the accompanying vaso-dilatation. In no case have I been able to persuade myself that it was of real benefit to the patient.

This experience seems to be similar to that of all others who have tried the operation of sympathetic ramisectomy in this country and in America. Similar results were also obtained in the two cases chosen by Hunter and Royle out of a series of twenty-five cases specially selected for the purpose, and operated upon by Royle in Boston in October, 1924.

It therefore seems unlikely that this operation will survive long as a method of treating spastic paralysis, and I would re-affirm my belief that for the treatment of uncomplicated spastic contracture Stöffel's operation on the peripheral nerves remains the best method hitherto devised. Physiologically, it is the nearest approach we can get to the natural means of regulating the strength of a muscular contraction.

Sherrington has shown that the tonic or postural activity of muscle is a proprioceptive reflex arising in the muscle itself. Further, Liddell and Sherrington have proved that the adequate stimulus for this reflex is stretching of the muscle. Thus, the tendency of the lower limbs to bend under the body-weight evokes a stretch reflex or tonic action of the extensor muscles, which persists as long as the stretching force is acting. This is the mechanism by which the upright position of the body generally is maintained. Normally, postural activity is found only in the antigravity muscles, that is, those which constantly resist and counteract the influence of gravity. The centre for this reflex is in the mid-brain, and it is known to be controlled and influenced by the labyrinths, the cerebellum, and the cerebral cortex.

I have dealt elsewhere [2] with the bearing of these facts upon the ætiology of postural deformities. Here I will only remind you that postural deformities are due to default of the normal postural activity of the muscles, and their treatment comprises: (1) correction of the deformity, if possible, and (2) re-education of the postural reflex.

For these purposes remedial exercises or gymnastics are extensively employed, consisting almost entirely of movements performed in various ways. And, in view of what has already been said, we may ask ourselves this question: If movement and posture are two entirely different mechanisms, what is the good of performing movements in order to educate posture? Experience proves that it is some good. Movement and posture, though distinct, are nevertheless closely associated. Postures are changed by movements, and change of posture is the adequate stimulus for postural activity. The important point is that it is not the movement *per se*, but the fixing of the postures attained by movement, that constitutes the real exercise.

There is too much arm-and-leg wagging in the schemes of most gymnasts. Conventional Swedish exercises are based upon the erroneous idea that postural deformities are due to weak muscles, and it is sought to strengthen these muscles by making them perform repeated movements.

An interesting experiment has been made in applying the technique of certain forms of dancing—so-called operatic dancing—to the re-education of posture. It is interesting because not only does it provide for most patients an attraction which is wholly wanting in ordinary remedial exercises, but the essence of this form of dancing is the posing or fixing of postures as distinct from the movements employed to attain them. A recasting of remedial exercises on these lines is long overdue.

But it is a mistake to think of posture as merely a state of immobility. Movement and postural activity are closely associated in many, if not most, of the ordinary actions of muscles.

It has been shown that the simple stretch or myotatic reflex, as Sherrington calls it, consists of two parts—a short-lasting relatively intense phasic reaction, and a less powerful, longer-lasting tonic reaction. So that, for instance, when weight is suddenly thrown upon a partly bent limb, there is a brief, powerful phasic contraction of the extensors to take up the sudden strain, and a prolonged tonic reaction to

maintain the posture, or in other words, to prevent the limb from bending. Thus, at every step in walking and running and in many other movements, a postural reaction is evoked which fixes the part, if only for a moment, in the position to which it has been brought.

Students are taught that the action of a muscle is the effect of approximating its origin and insertion. Thus, for example, the student learns that the action of the quadriceps is to extend the knee-joint. It is nothing of the sort. It is true that the quadriceps does extend the knee, but that is a very small part of its action. The great function of the quadriceps is to prevent the knee from bending. It is one of the great postural muscles of the lower extremity, and, as its action is of considerable interest and importance to orthopædic surgeons, it may well be taken as a type.

The functions of standing, walking and running, are essentially reflex in character. Of course they are influenced in various ways by voluntary action; but essentially they are reflex. The postural reflex activity of the quadriceps is essential for all these functions. Failing this, the individual may be able to control the knee for a time by an extraordinary voluntary effort. But voluntary effort cannot be continued indefinitely, and when it fails the muscle lets the knee down. This is the familiar condition of quadriceps insufficiency so common after injuries and diseases of the knee-joint, and it is noteworthy that powerful voluntary extension of the knee may be possible in cases of marked quadriceps insufficiency.

In every serious injury or disease of the knee-joint rapid wasting of the quadriceps is one of the first signs to appear, and the last to disappear. As we are now taking the quadriceps as a type, these remarks apply equally to many other regions of the body. So far as I know, no satisfactory explanation of this muscular atrophy has ever been suggested. It is much more than a mere disuse atrophy. It is obviously some active process. It has been called reflex atrophy; but what is reflex atrophy? There is no evidence of any specific trophic innervation of muscles.

I would suggest that there are two physiological factors responsible for this type of atrophy. One, a reflex inhibition of the postural or tonic activity of the muscle, about which there is no doubt whatever, and the other, a reflex excitation of the phasic activity of the same muscle, or, in other words, an attempt at reflex protective spasm.

Now, postural activity alone is able to maintain a state of tension for long periods with hardly any increase of metabolism, as in maintaining ordinary postures. With the help of postural activity a mild phasic activity also can be maintained very economically, as in the condition of decerebrate rigidity. But without the support of postural action, prolonged phasic activity is a most extravagant form of energy and it leads to a rapid using up of the materials from which the energy is derived.

Some years ago Langley [3] suggested that the atrophy of paralysis following peripheral nerve injuries was due, not to disuse, but on the contrary to excessive activity of the muscle brought about by the traumatic excitation of the nerve. He did not mention the tonic or postural activity of the muscle, but as this is abolished in peripheral nerve injuries, the same explanation may be applied also to this case.

It is worth while perhaps to consider for a moment the means which are commonly employed in treating quadriceps insufficiency, apart from the treatment of any underlying cause. The means are: (1) massage; (2) electrical stimulation; and (3) exercises consisting almost invariably of movements of extension of the knee. Each of these methods is capable of developing a wasted muscle, but not one of them is an adequate stimulus for the postural activity of muscle. Sherrington remarked upon the difficulty of producing anything approaching postural activity by artificial means, such as electrical stimulation. However, by what I regard as for the most part a fortunate accident, the mere development of a muscle makes it better able to regain its postural activity by taking natural exercise. But we have all met with cases of

quadriceps insufficiency which have responded to treatment up to a certain point and then have ceased to improve. It is well, then, to remember that the adequate stimulus to the postural reflex is stretching of the muscle, provided of course that the muscle is able to resist it; and cases of quadriceps insufficiency will often show an astonishing improvement as soon as they are put on adequate resistance exercises.

It is instructive to put beside this the well-known clinical fact that stretching of a muscle, when it fails to evoke the corresponding reflex, as in a paralysed muscle, is a most injurious factor.

Sometimes, when the quadriceps is paralysed, the operation of transplanting the hamstrings, or some of them, into the patella is performed with the idea that the transplanted muscles shall take the place of, and function as, the paralysed one. This operation is as physiologically unsound as it is generally useless. In such cases the patients are often shown at surgical meetings holding the knee extended or walking. But the condition is at best one of complete quadriceps insufficiency. Postural activity is not normally found in the flexors of the joint, and no one has ever yet succeeded in imposing a postural reflex on a muscle transplanted from the flexor group. Therefore, when the patient forgets his knee and ceases to walk with voluntary effort, as he must do sooner or later, the muscles let him down.

A similar objection applies also to some other tendon transplantation operations, especially in the lower extremity. For example, the peronei cannot be made to take on the postural action of the tibial muscles, nor can the tibials be made to take part in the stepping reflex which is normal to the peronei.

In contrast to these are some tendon transplantation operations in the upper extremity, notably that for musculo-spiral paralysis. Here the muscles are concerned with voluntary movements of precision, and the true substitution of one muscle for another is frequently possible.

There are many other questions concerned with muscular activity that one would like to hear discussed: (*a*) The influence of muscular activity on bone growth. (*b*) The significance of postural deficiency in rickets. (*c*) The nature of organic contracture of muscle. (*d*) What is cramp? (*e*) Is not chronic constipation a symptom, rather than a cause, of postural deficiency? And, if you think that here I have overstepped the bounds of orthopædic surgery, let me remind you (1) that there are many people who think that intestinal stasis plays an important rôle in orthopædic conditions, such as chronic arthritis; (2) that Sherrington has shown that the postural activity by which the muscular walls of the intestines and other hollow viscera adapt themselves to changes in the volume of their contents, is precisely similar to the postural activity of the skeletal muscles by which the upright position of the body generally is maintained; and (3) that Arbuthnot Lane has said that he was led to his views on chronic constipation by his observations on scoliosis. Now, scoliosis is a subject about which orthopædic surgeons, rightly or wrongly, think they know something; and surely, if it is permissible to argue from scoliosis to constipation, an orthopædic surgeon may be allowed to hold an opinion.

In these rather scattered remarks I have tried to indicate what I believe to be the most distinctive feature of orthopædic surgery to-day. A change is coming over surgery. The old surgery, by long tradition based exclusively upon anatomy and pathology, is passing away, and its place is being taken by a surgery that takes into account also the functions of the living body. In other words, mechanical surgery—mere technique—is not everything, and physiology is coming into its own.

In this respect orthopædic surgery undoubtedly leads the way, and it is already far ahead of any other branch of surgery. This is the explanation of the long treatment—often miscalled after-treatment—which is so unpopular with the surgeon who looks for quick returns, but which is so essential a part of orthopædic methods. This, also, is the reason why fractures must be treated by orthopædic methods,

whether by orthopædic surgeons or others. For a fracture is not only a broken bone but a grave disturbance of function, and we know to our cost—or should I say to our profit?—that the mere mending of a fracture in good position is not necessarily followed by perfect restoration of function.

The physiology of muscular action, with which I have dealt so imperfectly here, is but one instance of the fundamental relationship between physiology and orthopædic surgery.

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Section of Orthopædics.

President—A. S. Blundell Bankart, M.Ch.

Case of Unintentional Arthroplasty of the Hip.

By R. C. Elmslie, M.S.

Patient, a boy aged 10, attended hospital in March, 1922, with a history that a year before he had had some illness in the course of which there was a polyarticular arthritis resulting in a pathological dislocation of the left hip. An X-ray photograph of the hip showed a dislocation backwards of the head of the femur with disuse rarefaction, but without obvious erosion or destruction of bone.

Operation (May 8, 1923).—The adductors were first divided and an attempt made to reduce the dislocation. As this failed, an anterior incision was made and the hip-joint explored, the sartorius, rectus femoris and psoas being divided. A mass of fibrous tissue was removed from the acetabulum; the head of the femur and acetabulum were denuded of cartilage and the head replaced in the acetabulum, so that two raw bone surfaces were in contact. After closure of the wound the limb was fixed on a Thomas's splint with extension. Three weeks later the limb was fixed in plaster in a slightly abducted and flexed position. The plaster was retained until September, 1923, when a full length caliper splint was fitted and worn until September, 1925.

The joint now shows good mobility with about 50° flexion from the fully extended position, a moderate degree of rotation and very little abduction. The head of the femur rests in the acetabulum, and the hip-joint is stable; the joint is free from pain and is quite useful.

The case is of interest as showing the production of a good, stable, mobile joint after an operation in which all the cartilage was removed, no fascia or foreign material placed between the bone ends, and the joint immobilized in plaster for four months after operation.

Case of Charcot's Disease of the Hip-joint in a Girl aged 17.

By St. J. D. Buxton, F.R.C.S.

F. L., aged 17.

History.—Pain in the left hip and limp one year; a little limp for five years. Lately she has had a fear of falling down.

Past history.—Fell down stairs at school. Went to hospital in April, 1925, and was given a caliper splint and was told that she had a "tuberculous hip-joint." Has had measles and chicken-pox. Condition of eyes bad since she was 3½ years old, and at the age of 2 months she was treated at Charing Cross Hospital for "epiphysitis" in the arms.

Family history.—Mother in good health. Father a porter, who has "wounds" (? ulcers) in the legs. She has two sisters, one aged 15 and one 4. The girl aged 15 is tall and of a different appearance to this child, but I was not able to examine her.

Present condition.—Patient, a heavy girl who has a squint. Left hip—movements: flexion and abduction somewhat limited, and abduction painful after 30°.

Great trochanter raised 1½ in. Limb 1½ in. short. Trendelenburg's sign positive. Both the ankles are swollen, but there is free movement. There is some pain in the left ankle. The liver and spleen are not felt to be enlarged. Bridge of the nose sunken. Both eyes show choroiditis. Urine normal. Wassermann reaction positive (blood).

X-ray photograph of the left hip-joint shows head of femur to be not recognizable, the top of the neck is sclerosed; this is not opposite acetabulum. There is a large amount of new bone formation mostly on the ilium, about a migrated acetabulum.

X-ray photograph of the ankles shown.

Case of Charcot's Disease of the Spine.

By St. J. D. Buxton, F.R.C.S.

J. F., aged 45. Patient worked as a blacksmith in Kent until 1915, and served as a farrier during the War until 1919. He says he became unsteady on his legs in 1920 and in 1923, and that when he was in Bermuda he began to suffer from "spinal curvature."

Past history.—Patient states that he had syphilis in 1902 and was treated with pills for a year. During the war he had shooting pains in the leg, which were treated as due to neuritis of malaria. After the war he underwent salvarsan treatment and says he had a positive Wassermann reaction in 1920.

In 1921 he went to Bermuda, where he was given intravenous injections and underwent two courses of "osteopathic treatment." In 1923 his spine was put into a plaster of Paris jacket, as he was told he was suffering from spinal caries.

Examination.—Patient cannot walk without assistance. Spine: prominence of the lumbar spine with a slight curve to the right. Rigidity, but no pain. Reflexes:

knee- and ankle-jerks absent. Wasting of the thigh- and leg-muscles. Eyes: pupils unequal, reacting very slightly to accommodation, but not to light. Atrophy of right optic nerve; left disc very pale. There has never been any manifestation of suppuration. Wassermann reaction positive. An X-ray of the spine shows partial destruction of the third, fourth, and fifth lumbar vertebræ with a large amount of new bone formation.

The patient shows advanced signs of tabes dorsalis and the condition of the spine appears to be of the nature of a neuropathic arthropathy or Charcot's disease of the spine.

Anterior Dislocation of the Semilunar Bone, with Rupture of the Radial Artery.

By PAUL BERNARD ROTH, F.R.C.S.

GEORGE C. H., aged 42, was seen on October 19, 1925, a few hours after a backfire accident. There was a tense, tender swelling on the front of the right wrist, and a radiogram showed an anterior dislocation of the semilunar bone, with rotation on a lateral axis of 90°. An operation was performed on October 23, 1925, and the bone removed. It was lying proximal to the anterior annular ligament, and quite free except for an attachment to the radius. The radial artery was found torn completely across.

Genu Recurvatum following Excision for Tuberculosis.

By PAUL BERNARD ROTH, F.R.C.S.

G. W., AGED 52, was first seen on October 1, 1925, complaining of pain in his "dropped" right foot. On examination, this trouble was found to be secondary to the extraordinary degree of recurvation of the right knee, the leg making with the thigh an angle of 115°, with concavity forwards. A radiogram showed solid bony ankylosis, the medullary cavities of the femur and tibia being continuous.

Patient stated that his knee-joint had been excised in Guy's Hospital forty years previously. The knee had gradually bent backwards more and more ever since. Extensive survey of the literature revealed no mention of genu recurvatum as a sequela of excision of the knee.

A Case of Lumbar Sympathetic Ramisectomy, showing well-marked Vasomotor Paresis twelve months after Operation.

By A. S. BLUNDELL BANKART, M.Ch. (President).

MALE, aged 25. Diagnosis: transverse myelitis, paraplegia in flexion. Operation left side October 30, 1924. Operation right side January 15, 1925. Result: appreciable, though slight, diminution of muscular spasm. Well marked vasomotor paresis persisting to date.

Specimen of Secondary Ovarian Carcinoma of the Scapula.

Shown by A. S. BLUNDELL BANKART, M.Ch. (President).

PATIENT, a married woman, aged 30, with three children, underwent removal of a right ovarian multilocular cyst in April, 1922. Three years later (August, 1925) she developed pain in the left arm and swelling of the left scapula. A second ovarian cyst was removed by operation in August, 1925, and found to be a multilocular cyst one portion of which was definitely malignant. No other abnormality was seen in any other pelvic or abdominal organ at this operation. Meanwhile, the scapular tumour increased rapidly in size, and interscapulo-thoracic amputation was performed on October 3, 1925.

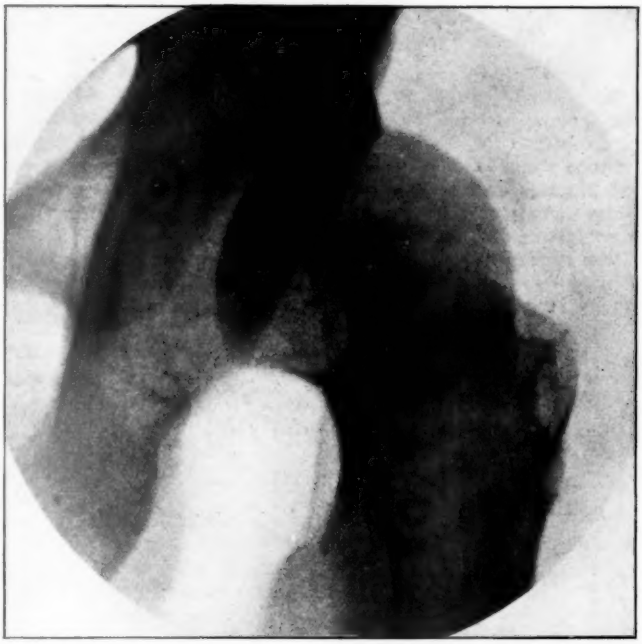
The specimen shows a large, soft growth of the neck and body of the scapula, breaking down in the centre. A microscopic section of the tumour shows invasion of bone and connective tissue by a colloid carcinoma with a high columnar epithelium lining cystic spaces, and proliferating in the form of papillæ, similar to the appearance found in carcinoma of the ovary.

Partial Anterior Dislocation of the Hip.

By J. W. Cory, M.B.

G. W. E., a powerfully-built man, aged 30, was brought to King's College Hospital on October 3, 1925, with pain in his right hip. He was playing football that afternoon on a ground which was hard, and he was using well-studded boots. He said that he was running with no one near him, when he turned sharply to his left; he fell with a sharp pain in his right hip.

When seen in the casualty department he was in considerable pain. There was a swelling the size of a tennis ball, very hard and fixed, situated in the groin



Partial anterior dislocation of right hip before reduction.

immediately below Poupart's ligament. The right leg was in external rotation, extended, but not hyperextended; no adduction or abduction was present. The great trochanter was difficult to feel, but was not raised. Movements were not examined, as any attempt at movement caused him pain. No vascular or nervous lesions were discovered in the limb.

The patient was put to bed and a weight extension applied to the leg. The swelling subsided considerably, but a hard lump still remained. X-ray examination showed the head of the femur to be a little high and possibly forward, but the swelling did not seem to correspond with the X-ray appearances. (Only A.P.

taken.) Mr. Fairbank saw the case and diagnosed a partial anterior dislocation of the right hip.

Patient was given a general anæsthetic, the thigh was flexed and extension applied to the leg while the pelvis was fixed by assistants. The extension was kept up for about a minute and the leg was then rotated internally. The head could be felt pivoting over a sharp edge, and at the third attempt it was felt to slip into the acetabulum. X-ray examination showed the head of the femur to be now in its normal relation to the acetabulum. Wool and a firm bandage were applied and the leg immobilized for a week. At the end of that time massage and electrical treatment were begun. He was discharged from hospital after three weeks and allowed to walk in four weeks.

Ununited Fracture of the Neck of the Femur in a Child.

By G. Perkins, M.Ch.

This child, aged 13, fell from a swing in the garden in April, 1925. She could not walk after the accident and was taken at once to hospital where she was kept in bed for three months. For the first two months the leg was slung in a Thomas's knee-splint with a weight traction applied through adhesive strapping on the skin. Movement at hip was encouraged from the commencement. After three months' recumbency she was allowed up, without splints.

She now complains of increasing pain in the hip.

Examination reveals the typical deformity and signs of an ununited fracture of the neck of the femur. X-ray examination shows a vertical fracture through the middle of the neck with half an inch separation between the fragments; the shaft of the femur is displaced upwards about an inch.

The case is shown on account of the youth of the patient.

A Case of Osteomalacia with Fibrocystic Disease.

By J. B. Barnett, F.R.C.S.

Patient, a girl aged 16, states that her disability was first noticed after an attack of influenza four years ago. The first trouble noticed was a knock-knee, which was corrected by operation. On getting up after this, she felt weak and "wobbly." Two years ago she fell and broke the right humerus, and some weeks after, attended the Poplar Hospital. At this time, some exaggeration of the normal curves of the long bones was observed, with an increase in the deep reflexes and wasting of muscles. No diagnosis seems to have been made, but an osteotomy of the right femur was performed.

On admission to hospital, after a year in another institution, she was unable to stand. Movement at the knees was restricted to a few degrees of flexion from full extension, with a severe back-knee. The feet were dropped, and the muscles of the legs weak and wasted. Of the reflexes, knee-jerks were difficult to elicit; the plantar reflex was flexor; the epigastric and pupillar reflexes appeared to be normal.

X-rays show a general thinning of the bones of the pelvis and lower limbs (fig. 1). In the lower end of the right femur there is diffuse mottling (fig. 2), and in the upper end of the left femur a loculated cyst. In the upper third of the shaft of the right radius is a loculated, cystic expansion of the bone, abruptly limited above and below, which has thinned the compact layer to a fine shell.

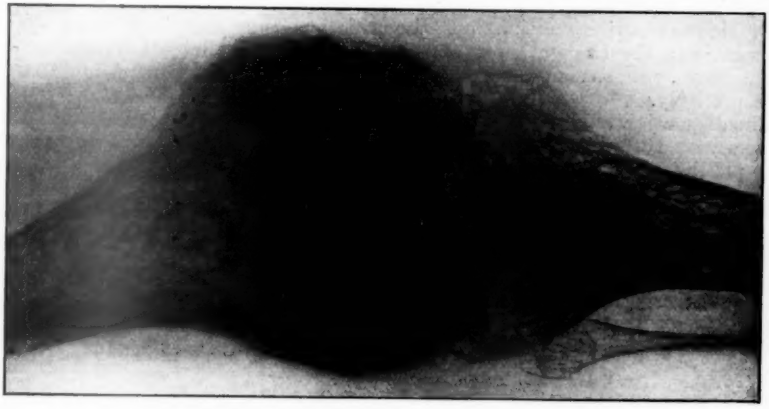


FIG. 2.

FIG. 1.

The cranium would appear to be abnormal in shape and size, and there is a bilateral swelling of the lower jaw, which is said to be a constant feature in multiple fibrocystic disease.

Of blood and urinary estimations, the urinary calcium and phosphatic content is increased, and the blood-calcium and phosphates have increased by rather more than 1 mgm. per c.c. in the last two months, the figures now being 15·4 and 6·6 respectively.

The diagnosis would seem to lie between multiple fibrocystic disease and osteomalacia, with the weight of evidence in favour of the former. The age of onset, about puberty, the type of onset, with softening of the long bones, weakness, and limitation of movement, seem characteristic of multiple fibrocystic disease, as also the local, loculated cystic growths. On the other hand, a congenital type of osteomalacia is said to occur, and the widespread bone softening—far more than can be accounted for by disuse—and the pathologist's estimations of the blood and urine must be considered.

In the treatment, constitutional rather than local measures would appear to be indicated—perhaps of an empirical nature, such as glandular extracts.

Section of Orthopædics.

President—A. S. Blundell Bankart, M.Ch.

DISCUSSION ON THE TREATMENT OF FRACTURES OF THE FOREARM, EXCLUDING FRACTURES OF THE OLECRANON AND THOSE OF THE LOWER END OF THE RADIUS OF THE COLLES TYPE.

Mr. St. J. D. Buxton, F.R.C.S.

The importance of this subject is realized by all of us, probably for two reasons: First, because fractures of the forearm are very frequent, and secondly, because a "bad result" from any fracture makes us feel that we did not direct the treatment correctly.

In order to appreciate success of any treatment it is necessary to realize the condition before treatment, and to see the result, not only at the end of the treatment, but also some months and years afterwards. It would be a simple matter to exhibit X-ray photographs of fractures and of the united bones, but this is only one side of the treatment of fractures. Photographs of the movements a patient can make after a fracture appear to me to be somewhat deceptive—a view one adhered to more strongly after a previous discussion here. I should like to show you many patients who had broken a forearm a year or so ago, but this, unfortunately, is impossible. Hence it is difficult to do more than state the principles employed in the treatment of fractures of the radius and ulna. Fortunately it has been possible to examine a number of forearms which had been treated in 1924 and since, but in most cases the patient was examined last when treatment was stopped, or a month or so later. If results are stated as "perfect" or "movements slightly impaired" such results are judged in most cases by my colleague in charge of the massage and electrical department.

Before dealing with individual fractures it is my intention to lay stress on what are called general principles, for these must form the basis of the treatment. The first consists in the correction of displacement of the fracture. The second in the fixation of the fragments for a sufficient length of time to prevent the risk of displacement. It appears, however, that those who treat fractures are not entirely in agreement concerning these general principles.

In dealing with the forearm the particular objects of treatment are: (1) To prevent permanent deformity; (2) to preserve the movements of supination and pronation.

In the case of fractures of the head and neck of the radius our object is to preserve the movements of flexion and extension at the elbow as well as those of supination and pronation. For the function to be normal after a fracture it is essential to have united bones and a healthy condition of the muscles, joints and a normal nerve- and blood-supply. Each of these is a matter of consideration for the surgeon, and it is for him to direct the masseur, who so often prefers to use his own hands instead of making the patient use his own muscles and move his own joints. In fact, one is inclined to formulate a third general principle and call it "the performance of active movements." This principle, however, is not stated, for it is likely to be misunder-

stood. Finger movement is encouraged from the commencement of treatment after fixation of the fracture, but wrist movement in a fracture an inch or two above the joint is likely to cause movement at the site of fracture. Possibly, in the hands of a skilful surgeon or masseur, measures can be adopted to prevent any movement occurring at the site of the fracture, while the wrist is moved, but it is obviously unsafe to recommend a line of treatment that can only be ideal in the hands of a few.

The relation of the anatomical and functional result is invariably discussed when dealing with forearm fractures. In view of the line of treatment adopted in these cases it is unnecessary to do more than state the fact that—especially in forearm fractures—even if a good functional result occurs, when the anatomical alignment is poor, this is obtained only after a long disability time. Children certainly have marvellous powers of compensation, so that deformities of the radius and ulna may be eradicated to a large extent as the limb grows. The correct anatomical alignment is of importance in the forearm because: (1) a slight variation in position of the bones is sufficient to impair considerably, or prevent completely, movements of the radius on the ulna: (2) narrowing of the interosseous space may be followed by cross union.

In dealing with each fracture of the forearm one does not prescribe treatment until the case is seen with the X-ray photograph.

Briefly, we have to consider: (1) Site of fracture, amount of swelling, presence of complication such as vascular or nerve injury. (2) X-ray appearances whether the bones are in good position, malposition, &c. (3) Method of correction. (4) Further X-ray appearances if there is malposition. (5) Line of treatment required if still in malposition. (6) Method of fixation. (7) Treatment by the masseur—massage and movements, &c.

General Considerations of Treatment.

Fractures of the head and neck of the radius will be discussed subsequently, for their treatment raises problems of a different nature from those of fractures of the radius and ulna elsewhere. Before dealing with particular fractures the general line of treatment can be considered aptly, if the fractures are divided into three groups:—

(I) Fractures of one or both bones with *no* displacement. (II) Fractures of a single bone with displacement. (III) Fractures of both bones with displacement.

(I) *Fractures with no Displacement or Angulation.*

No correction is required, the forearm is splinted in full supination, with the elbow flexed to a right angle, by the method which will be described subsequently.

Finger movement is encouraged immediately after fixation, and wrist and elbow movement, under a masseur's supervision, after a fortnight. Massage, at first with the arm on the posterior splint, is employed after a few days in adults, but is not used as a routine in children.

It is universally agreed that these fractures should be followed by a perfect arm, but three points are worthy of consideration: (*a*) The avoidance of over-treatment. (*b*) The prevention of circulatory disturbances. (*c*) The prevention of joint stiffness.

Tight fixation may be followed by circulatory disturbance and prolonged fixation by joint stiffness. Excessive zeal in the prevention of joint stiffness may cause frequent movement between the fragments, and delay in union.

(II) *Fracture of a Single Bone with Displacement.*

When one bone remains intact, it undoubtedly exerts a splinting action which in many cases is of assistance in the treatment. Conservative treatment can be employed in a number of cases, particularly in children, but operative treatment is required in others, especially in the case of the radius. These cases will best be considered when fractures of the radius and ulna are discussed separately.

III) *Fractures of Both Bones with Displacement.*

These fractures produce far greater difficulties than those hitherto discussed. The difficulties arise because:

(*a*) There are four fragments, which require re-alignment;

(*b*) There may be much tissue between the fragments;

(*c*) Deformity may be in four directions: (i) antero-posterior, (ii) lateral, (iii) rotatory, (iv) overlap.

(*d*) Traction, as a means of correction, is not followed by great success such as one anticipates in many fractures of the femur. The deformity must be reduced and there are three methods available:—

(1) *Closed* reduction under anæsthesia. If after a fair trial this is not successful,

(2) Open reduction is required.

These two methods will be fully discussed after brief consideration of:

(3) *Traction.* This cannot be depended upon for the correction of forearm fractures. It is suitable in cases in which operation is contra-indicated and in which closed reduction has been tried and failed. It is employed as a routine in extensive compound fractures.

(1) *Closed reduction.*

(*a*) Ether anæsthesia is preferable to that under nitrous oxide and oxygen, as perfect relaxation of the muscles is assured and this relaxation will remain over a longer recovery time—an advantage to the patient as well as to the surgeon.

(*b*) The *reduction* should be undertaken as early as possible after the fracture, so that there has not been time for the muscles to contract. Hence, in hospital practice the casualty officer has a greater chance of reducing these fractures than the visiting surgeon, who sees the case a day or so later, when there may be considerable swelling, as well as muscular contraction. Counter-traction is applied by an assistant, who holds the elbow flexed and pulls on the upper part of the forearm. The surgeon grasps the wrist and applies traction with one hand, manipulating the fragments with his other hand. Gentleness should be employed, for brute force will cause further injury to the soft parts and is not likely to assist in bringing the bones into alignment.

(*c*) *Fixation* is required after reduction. The limb is kept flexed at the elbow and the forearm fully supinated. Full supination is employed because:

(i) Rotatory displacement of the radius is prevented.

(ii) The radial convexity is preserved.

(iii) The radius and ulna are well separated, which helps to prevent synostosis between the two bones.

(iv) It is the optimum position of recovery of function. This is the case, because in almost all movements of the hand, the motion is from supination to pronation. Hence "use" of the hand will subsequently bring recovery of pronation, but not necessarily of supination.

Two methods of fixation are used; either (*a*) a posterior right-angled wooden splint with a short wooden splint for the flexor surface of the forearm, or (*b*) plaster.

(*a*) I have no experience of fixation with the elbow extended, except when applying traction, and I deprecate the use of the anterior angular splint, because it may cause pressure on the front of the elbow, and early treatment of the forearm necessitates the removal of this—the principal splint. The padded posterior angular splint extends nearly to the axilla above, and below to beyond the knuckles. The anterior splint extends from an inch below the bend of the elbow to the bend of the wrist. The splints are well padded and the posterior splint is applied first after the limb is powdered. The forearm is held between the two, while two straps and buckles, or two pieces of inch adhesive strapping are applied round the splints below the elbow and above the wrist. A bandage is then applied and the splints and arm

placed in a large arm sling. It is important that the anterior splint should not press into the elbow and compress the brachial artery, and that it should not press into the base of the thumb. A pressure-sore in the latter situation is not at all uncommon after too tight application of splints. Should the correction be almost perfect, but slight angulation persist, pads of felt may be placed over the angulation to aid correction.

(*b*) Plaster is used in a number of cases. Its advantages appear to be: (i) it assures firm fixation; (ii) it does not cause flattening of the flexor surface of the forearm. Its disadvantages are: (i) the danger of pressure on the vessels, especially when swelling of the limb occurs subsequent to the application of the plaster; (ii) it is not always easy to prevent recurrence of the deformity during the application of the plaster. It is used: (1) when wooden splints do not prevent recurrence of the deformity after reduction; (2) after a second closed reduction—that is, when the first has failed; (3) in cases in which operation is contra-indicated and correction of the deformity is not obtained; (4) in the case of a number of children, whose splints are not attended to by the parents; (5) after operation, which will be mentioned later.

The limb is powdered, covered with flannel bandage and plenty of wool and the plaster applied from just below the axilla to the knuckles. The elbow is put at a right angle, the forearm fully supinated and the wrist dorsiflexed. It is my custom to make a cut along each side of the plaster as soon as it has set. This cut being through nearly the whole thickness of the plaster makes it easier to bivalve the plaster at the end of a fortnight, or to remove it, should some tragic complication be feared.

(*d*) After the fixation the forearm is X-rayed, and if the position is unsatisfactory the question of operative treatment is considered. Before considering this, reference will be made to the *dangers* that may occur.

Ischæmic Paralysis.—Possibly an apology is necessary for mentioning this, but the serious aspect of circulatory interference caused by improper fixation should be kept prominently before each one of us. Hence, in order to prevent ischæmic paralysis, care must be taken that in the neighbourhood of the elbow no pressure is exerted on the brachial artery. After application of plaster or splints, the finger nails should be inspected to make sure that the circulation is satisfactory. The patient should be told to see the surgeon within twenty-four hours of the first fixation, or earlier, if the fingers cannot be moved, or if the hand has become swollen or blue.

(2) *Open Reduction or Operative Treatment.*

This is indicated when the attempt at closed reduction under an anæsthetic has failed to correct the deformity and hold it corrected in splints. Sometimes a second attempt at closed reduction is made, usually when the first has been made by one who is somewhat inexperienced. An X-ray picture, showing the antero-posterior and lateral view, will indicate whether the reduction is held corrected. Operative treatment is required in many adults and in a number of children. In fact, reference to the number of operations for fractures seen at the fracture clinic of my hospital shows that open reduction is resorted to more frequently for fracture of the radius and ulna than is the case with many other fractures. In advocating open reduction for these cases it is necessary to make the proviso that such a procedure is only justifiable under perfect operative surroundings by those familiar with bone surgery, and that it should not be undertaken while the skin cannot be rendered surgically clean, owing to any abrasions.

Operative procedure is best carried out between the fifth and tenth day after the fracture. The routine employed is briefly as follows:—

(1) Two-day skin preparation.

(2) A blood-pressure apparatus is used as a tourniquet, the pressure being kept at 200 mm. of mercury.

(3) Subperiosteal exposure of the radial fragments.

(4) If these cannot be brought into correct alignment, the ulnar fragments are exposed through a second incision, and their position corrected.

(5) The radial fragments are then re-aligned.

(6) Fixation: (*a*) In children and in a few adults, if the operation is performed within ten days after the fracture, no internal splinting is usually required. The fragments are made to interlock and will remain in correct position. The limb is held by an assistant in the correct alignment while the wound is closed. After this open reduction the limb is put in plaster in full supination. (*b*) For the majority of adults and for a few children internal splinting is required. The radius is plated in these cases, and generally no plate is put on the ulna. In this type of case the limb is splinted until the stitches are removed and it is then put into plaster. Reference to other forms of operative treatment will be made subsequently.

Special Fractures.

Ulna.

(1) *Fracture of the Ulna alone.*—This does not appear to be very common in our clinic. Of twenty cases investigated none required an anæsthetic for correction of deformity. Two cases underwent operative treatment, but neither of them for correction of position; one fracture was compound, so that a primary excision of the wound was performed, and the other was operated upon to prevent it becoming compound, owing to a spike of bone tending to come through the skin. These cases are treated on the splints described above and the after-treatment will be considered conjointly with that of other special fractures. All the cases are reported as being discharged with union and full movement, except that of a child, aged 5, who had limited extension three months after a fracture of the upper third of the ulna. Non-union is undoubtedly rare, and war experience shows that non-union in the lower third is not incompatible with good function.

(2) *Fracture of the Ulna with Dislocation of the Head of the Radius.*—The reduction of the dislocation is of greater importance than the re-alignment of the ulna. After this has been accomplished the forearm is fully supinated and flexed.

Radius.

Fracture of the Shaft.—Of about fifty fractures forty required no correction under an anæsthetic, but pads of felt were used in a certain number in order to correct slight angulation. Five cases were corrected under an anæsthetic and five were operated upon owing to deformity. The operation performed was an open re-alignment and fixation by a plate if the fragments would not remain in position. On discharge from the fracture clinic, or massage department, of the fifty, six are stated to have impaired movement, but none non-union. Fractures of the upper third probably require operative treatment more often than others, and in operating on these care should be taken to avoid injury to the posterior interosseous nerve. In considering these fractures a number of patients seek treatment some months after their injury, when there is non-union of bone. This almost invariably requires operative treatment, and will be discussed under mention of non-union of both bones.

Fractures of the head and neck of the radius will be dealt with when details of the other fractures have been mentioned, as they present different problems.

Fractures of both Bones.—The line of treatment of these fractures has been fully discussed. Excluding greenstick fractures, a certain amount of information has been obtained of sixty-three cases, forty of which were in children under 15, and twenty-three in patients over that age. The majority were given gas or ether for closed reduction. Of the forty children eleven underwent open reduction, with or without plating. Of the twenty-three over the age of 15, nine had open operation for the reduction of the deformity. Of the sixty-three all were discharged, as

having good or perfect movements, except twelve. Of these, two were adults who were discharged with some limitation of pronation and supination. The other ten were children who were discharged with some impairment. One case was under treatment for ten months owing to a slight Volkmann's ischæmic paralysis. Of the *complications* that occur, re-fracture is common in children, and angulation may occur in adults if work is commenced too soon after splints are discarded. A labourer should not begin work again for three months after the fracture. Delayed union and non-union are not infrequent. This statement is fortunately not based on the cases from the fracture clinic, but from those sent to the orthopædic out-patient department after treatment elsewhere. If the usual non-operative treatment of non-union fails to improve the condition operative treatment is indicated.

The ends of the bones are cleared of fibrous tissue and interposed muscle, and the fragments aligned. Fixation is advocated by a bone-graft, but a dovetail fixation without graft may produce the desired result, although there is likely to be some shortening of the forearm.

A somewhat unusual fracture of radius and ulna came to my notice twice last year in the case of two boys aged 16. The radius was fractured transversely about 2 in. from the lower end, and the lower epiphysis of the ulna was split vertically with displacement forward of one fragment. In each case I removed the loose fragment which was lying among the tendons just above the wrist-joint. Six months later the function was good, but it is too early to see whether there will be interference with growth of the ulna.

Greenstick Fractures of the Forearm.—Reference must be made to these fractures because they are common—about two a week is the average at the King's College Hospital Fracture Clinic—and because a few features require consideration.

(*a*) Angulation is not uncommon, occurring in about one of every ten cases. It is recommended that this be gently corrected, or rather over-corrected, under an anæsthetic (gas will usually suffice), and splinted with a posterior angular splint and an anterior splint. A pad of felt should be placed over the site of angulation. If these fractures are not carefully splinted with pads the deformity tends to re-appear. From experience one becomes inclined to think that it is often necessary to cause a complete fracture in reducing the deformity when there is much angulation.

(*b*) Re-fracture of a greenstick fracture appears relatively common even eight weeks after the first injury among the poorer classes, so a sling should not be discarded too early, although splints are not required after four weeks.

(*c*) Volkmann's ischæmic contracture will occur in the splinting of greenstick fractures as with others. One case in the series investigated unfortunately exemplifies both the last two conditions.

Boy, aged 9. Greenstick fracture lower 1/4 radius and ulna, January 8, 1924. Discharged February 19, 1924 and told to use sling for two weeks. Re-fracture April 24, 1924 (fifteen weeks after). The skiagram suggested this was a fracture exactly through the site of the previous fracture. He was splinted in the casualty department and developed a slight ischæmic contracture, which necessitated six months' treatment.

After-treatment.

Massage and Movements.

In fractures of the radius or ulna alone massage should be begun before the end of the first week, at first by removal of the anterior half of the splint only. Finger movement is encouraged from the first and the wrist and elbow-joints moved under supervision before the end of the second week, and active movements before the end of the third. If the position is perfect, splints are discarded in four weeks in the case of a child and a little later in that of an adult, and a sling is worn for three

weeks. When both bones are broken, greater care must be exercised in the movements, and, although each case must be treated according to the rapidity of the union, a splint must usually be worn for seven weeks and a sling for two or three more. After operative treatment it is my custom to employ longer fixation before using massage, and, when this is first employed, the limb is not removed from the posterior half of the splint.

Fractures of the Head and Neck of the Radius.

This group of fractures must be viewed in quite a different way from those which have already been discussed. From the standpoint of treatment these fractures are classified in two groups: (1) Fractures with little or no displacement; (2) fractures with displacement.

(1) *Fractures with little or no Displacement.*—In this category are included the various types of fissured fractures of the head and impacted fractures of the neck without displacement. These cases should be treated with the forearm fully flexed and supinated.

If the limb cannot be brought into this position, when the patient is first seen, the position should be approached as near as possible and the arm and forearm fixed by bandages or a "collar and cuff." The next day greater flexion can usually be obtained, and after two or three days the desired position is reached.

Two patients were given gas, for the arm to be flexed. One was a boy, aged 11, with an impacted fracture of the neck. Full flexion was obtained without employment of any force in each case.

This position should be kept for two to three weeks, when the limb is let down gradually, the patient wearing a sling. Active movement is then encouraged and assisted by faradism to the muscles of the arm and forearm. Massage about the elbow is not employed.

It has been possible to study the results of about thirty cases, and I am impressed by certain findings. First, with regard to the movements, it is found that after ten to twelve weeks, pronation and supination are usually not impaired, whereas a full range of extension is seldom obtained. At a later date the extension is, very frequently, similarly limited. Cases have come for treatment late—usually those diagnosed as a sprain at the time of the injury—and these cases are more likely to show limitation of flexion and extension than of pronation and supination.

Secondly, the patients complain for some weeks that the arm is weak. The X-ray photographs of some of these cases do not lead one to think there has been injury to the orbicular ligament or interosseous membrane.

A series of radiographs of a fissured fracture show the course of union of the fragment and one learns from this case that further union certainly occurred after eight weeks from the time of the fracture. This series illustrates the arm of a nurse, who complained of the weakness for fourteen weeks, so that she could not do full duty for four months. At the present time, nearly three years after the injury, she has perfect use of her arm.

In the only article on this subject that has appeared in the English medical press during the last two years it is stated that function is perfect in two to three weeks after the injury. Unfortunately my own experience is contrary to this.

(2) *Fractures with Displacement.*—These fractures are far more serious in their effects than those of the last group, and discussion on their treatment is very desirable. It is necessary to consider two types: (*a*) Fracture producing one loose fragment. (*b*) Extensive comminution of the head, which will include the variety sometimes called "mushroom fracture." Unfortunately the comminution is often associated with fracture of the olecranon or of the lower end of the humerus,

and some of the most difficult cases to deal with have been associated with a posterior dislocation of the elbow-joint.

(*a*) *Fracture with One Loose Fragment.*—The early removal of this fragment is indicated. If two-thirds of the radial head is undamaged, and at operation full supination and pronation can be obtained, the edges of this are trimmed and the wound closed. If the fragment is large, it is better to remove the head as well as the fragment. The arm is stronger if the greater part of the head can be retained, but full movement has not been obtained in the cases in which this has been done. It is usual to find full flexion and supination possible, extension and pronation each being slightly limited.

Until recently that has been the line of treatment adopted, but in view of the fact that the fissured fractures are followed by better results than those in which a loose fragment has been removed, the question arises as to whether in any cases these loose fragments are replaceable. It is considered that this is worthy of trial if the skiagram shows that the loose fragment has a small attachment and is displaced in one plane only. My experience of this treatment is too recent to enable me to speak of results. Two methods of attempt at reduction are possible. First, the arm can be put in full flexion under an anæsthetic, and if the X-ray shows reduction of the fragment, the arm is retained in the position. Secondly, the head and neck of the radius can be exposed by open operation, and if the fragment is not entirely loose, but attached as it were by a hinge, removal of blood-clot may make it possible to re-align the fragment. Such a fragment may remain in position when the arm is fully flexed. If it does not do so it should undoubtedly be removed.

(*b*) *Extensive Comminution of the Head.*—My experience of these cases is chiefly after a dislocation of the elbow has been reduced. Two lines of treatment warrant discussion.

(i) *Operative Treatment a Week or so after the Injury.*—This consists of removal of the fragments and the upper end of the radius, including a portion of the neck. My experience of this has not been satisfactory, considerable limitation of movement resulting in some cases. The objections to this procedure are (1) that it is very difficult to remove all the fragments in many cases, and (2) that the trauma resulting both from the accident—necessarily severe—and from the operation, stimulates bone production, so that new bone may form at the edges of the upper end of the radius and each little fragment left behind may grow. The latter may form loose bodies or, if they are adherent to the capsule of the joint, limit movement.

(ii) *Late Operative Treatment.*—After the injury, the arm is fully flexed and supinated under an anæsthetic and after three weeks gradually let down, full flexion being performed actively each day. The case is kept under observation and the patient X-rayed periodically until bone-growth is apparently at a standstill. Then operation is performed and the head and neck and fragments of the radius removed. Further bone-production is not likely to occur. The fragments have usually united into a large mass of bone. The objections to the early operation are overcome by the late operation, but the chances of the patient getting osteo-arthritis are probably increased. One has been forced to this method in certain cases in which the skin was extensively blistered and lacerated at the time of the injury, and the results are very encouraging.

A man aged 24, who fell 24 ft., dislocated his elbow and had a comminuted fracture of the head of the radius. Pieces were displaced chiefly upwards; the elbow was swollen to twice its size after the dislocation had been reduced. Operation was performed six months after the injury. He was examined eight months after the operation, when his movements were free from pain. He had full flexion and supination. Extension was limited by 20° and pronation very slightly.

Hence it appears that discussion of the merits of early and late operation in these cases is of importance.

In connexion with operative procedures on the head of the radius, I have had no experience of fixation of fragments by metal or bone pegs. The posterior interosseous nerve should not interfere with the exposure of the radial head and neck.

In conclusion, I wish to express my thanks to Mr. Fairbank and Dr. Clayton for allowing me unlimited scope in investigating notes of cases and for much help in dealing with many of these fractures.

Mr. H. A. T. Fairbank

said that he was in agreement with the great majority of the remarks of the opening speaker (Mr. Buxton). There were a few points to which he would like to refer.

Reduction at the earliest possible moment was unquestionably advisable, particularly in the case of fractures of both bones with overlapping. Just occasionally it was possible to get the fragments in such a case to hitch end to end; if not seen early he believed it impossible to correct the displacement by manipulation, and he invariably recommended operation.

He used the full supination position as a routine, but this was not essential in fractures of the lower quarter of the forearm. Fractures of both bones in this situation he considered the commonest fracture of the upper limb in children. It took the place of the Colles fracture in adults. These cases did equally well on a Carr's splint or a posterior supination splint. Occasionally, when a case was only seen several days after the injury, it was inadvisable to insist on the fully supinated position, particularly with fractures in the middle third: when the limb had been in the mid-position since the accident, it was better to apply plaster of Paris after correction with the forearm in this position. Muscles in the region of the fracture, particularly the pronator radii teres, might become infiltrated and stiff with the bones in the mid-position, and fixation in full supination sometimes produced marked angular deformity of the radius.

He found fractures of the upper third of the radius extremely difficult to deal with, particularly when the fragments were displaced inwards and forwards across the front of the ulna. Full manual over-correction, such as Mr. Buxton mentioned, was essential before the application of a plaster cast, which had to be very carefully added and moulded to maintain correction. If this method failed, operation was certainly necessary.

He agreed that active movements of the fingers should be encouraged from the first, as a routine, but there was one exception, namely, fracture of both bones of the forearm with overlapping, when, for some reason, operation was contra-indicated. Early active movements in such a case undoubtedly increased the shortening, and should be replaced by passive movements of the fingers.

The risk of "cross union" he regarded as much exaggerated. For practical purposes it only occurred in severe compound fractures, particularly gunshot wounds, where the bone-forming cells were blown into the tissues between the bones.

As regards splintage in children, he preferred plaster applied a few days after the accident and left on for four weeks, and no after-treatment was necessary in the majority of cases except encouragement to use the limb. To a posterior angular supination and an anterior splint, he often added a narrow, straight wooden splint on the inner side of the forearm. This was particularly useful after open reduction without plating and while the patient was in bed, as it prevented lateral angulation of the fragments, which was apt to occur, in either direction, as the arm lay on a pillow. He usually found five weeks sufficient for splintage in adults.

Operation, when necessary, should be done as early as possible, especially in children. He saw no advantage in delaying operation for some days. In his experience it was exceptional to find muscle between the fragments. In transverse

fractures, particularly in younger patients, he rarely plated, while in oblique fractures plating the radius, at any rate, was usually necessary.

Ischæmic paralysis he regarded as excessively rare in forearm fractures: in his experience it had occurred with grossly displaced supracondylar fractures of the humerus. He could not help feeling that direct pressure by the displaced upper fragment at the bend of the elbow was responsible for the interference with the blood-supply, and not the pressure of splints applied to the forearm, though this might well be a contributory factor.

As to fractures of the head and neck of the radius, he certainly favoured the "wait and see" policy. If a fragment of the head were grossly displaced or the head itself was loose and markedly rotated, he favoured immediate operation, but he would not remove more than was absolutely necessary, and in any doubtful case he would postpone operation. Removal of the head of the radius should not be lightly undertaken, as a grave disability might follow. He had seen a child of 12 whose right arm was 2½ in. shorter than the left and was hardly used at all. The head of the radius had been removed, no doubt correctly, at the age of 3 for injury. The disability that sometimes followed removal of the radial head in adults was, he believed, well recognized.

Dr. James Mennell

suggested that various advantages were to be gained from treating the shafts of both bones of the forearm in extension, using a moulded gutter splint to maintain position. He emphasized the importance of the oblique fractures of the shaft of the ulna which allowed of the upward dislocation of the head of the radius in front of the lower end of the humerus; as, although the fracture was comparatively rare, he usually saw it at a late stage when it was a question of trying to relieve someone who had fallen into the trap by not recognizing the condition present.

Speaking of the transverse fractures of both bones, he said he felt that reduction of the overlap, if it could be effected at all, could only be performed very soon after injury, and that futile attempts to secure a well-nigh impossible objective would often do far more harm than good. If these patients for some reason or another were not subjected to operation, it should be possible to guarantee a minimum of 90° of rotation of the forearm.

He advocated the use of full passive movement, from the outset, of fractures at the head of the radius when it was certain that synovial fluid had escaped between the fragments, but he strongly warned against the abuse of early movement in cases in which there was the least chance of the synovial fluid failing to act as an impediment to new bone formation.

As regards operation, if there seemed to be no chance of regaining 60° of pronation and supination, it would, he thought, be better on the whole to excise the head of the bone at the early stage instead of waiting. In this instance, as in all other cases in which rotation was certain to be limited in the end, it was better not to aim at securing complete supination, as the most useful range for 90° of movement was 45° on each side of the mid-position.

Mr. E. G. Slesinger

said that in the Fracture Department at Guy's Hospital fractures of the shafts of both forearm bones represented 15 per cent. of upper limb fractures and occurred most commonly under the age of 20.

The treatment was based on the general principles governing the treatment of all upper limb fractures. Functionally, the muscles of the upper limb consisted of two groups, those acting against gravity—the gravity-opposing muscles, and those acting

with gravity—the gravity-aided muscles. The gravity-opposing muscles being the most important should always be kept short during treatment; in other words, the limb should be put into the full anti-gravity position, which in the forearm was full supination and flexion at the elbow. This was done by means of a supination plaster. He was surprised to hear Dr. Mennell's dislike of plaster, as in his (the speaker's) hands it gave every satisfaction. If the gravity-aided muscles had not recovered after treatment, that is, in case of deficient extension at the elbow or loss of pronation, this could be regained by aiding gravity, by putting weights on the wrist. The weights used were malleable lead strips put on and sealed on as bracelets, a weight of 5 to 8 lb. being used, and if worn for two or three weeks they almost always restored the lost movement.

He said he thought Mr. Buxton's difficulty in reducing overlap fractures could often be overcome by making the fracture worse by angulation, so as to break down the longitudinal compartments, and then securing reduction. Fractures of one bone only were far more difficult to reduce, particularly in the radius, and very frequently they required plating. In fractures of the head and neck of the radius the vertical fractures with no gross displacement were treated in the anti-gravity position followed by bracelet weights, and the comminuted cases by excision of head and neck of the radius. He had not been in the habit of waiting in these cases before operating, but thought that might be a good plan in very comminuted fractures, although usually immediate excision gave satisfactory results.

Mr. Harry Platt (Manchester)

referred to the frequency of forearm fractures as seen in the ordinary routine of a fracture clinic. For example in his own clinic in a consecutive series of 376 upper limb fractures, 100 were fractures of the shafts of the forearm bones. Of these 50 per cent. were combined injuries of the radius and ulna; isolated fractures of the radius were commoner than isolated fractures of the ulna. It was to be remembered that a considerable proportion of these occurred in children, the fractures being of the greenstick type. There was a tendency to consider greenstick fractures as relatively unimportant, and easy to treat. On the contrary, they presented a very definite mechanical problem, owing to the frequent development of secondary bowing in the first two weeks after the injury. He considered that it was essential to reduce the majority of greenstick fractures thoroughly, by making the fracture complete. Where this was done as a routine, secondary deformation rarely, if ever, occurred. After correction of the initial deformity, the best form of immobilization was an accurately applied plaster of Paris cast with the forearm in full supination.

Combined fractures of the shafts of the radius and ulna, in adolescents or adults, were often difficult to treat owing to the complicated displacement. In a great many cases, end-to-end apposition of the bones could be obtained by manipulation alone, and the correct position could be maintained best of all in a plaster of Paris cast, the position of full supination with the elbow flexed to a right angle again being used. But it was necessary to reduce a fair proportion of such injuries by an open operation. In his experience, some form of internal fixation was usually demanded, and he had used with success short intramedullary bone pegs. It was necessary to remember that after open fixation by bone pegging, union was slow, and that the retentive splints or plaster should be kept on for some six weeks.

He (the speaker) had found fractures of the head and neck of the radius to be relatively uncommon as compared with the other types of elbow fractures, viz., in 329 consecutive elbow fractures, thirty-nine were fractures of the head and neck of the radius. It was interesting to note that 90 per cent. of the cases were produced by direct violence. In the fractures in which there was a simple split of the head, or

a transverse fracture of the neck without displacement, full function was usually restored by conservative measures.

The question of operative treatment in fractures of the head and neck of the radius was very difficult. On the whole it seemed wise to treat all cases conservatively in the first few weeks, except where a large isolated fragment was displaced. Early operation, where comminution was present, gave disappointing results for reasons which had been well explained by Mr. Buxton. If at the end of six weeks' conservative treatment the range of rotation of the forearm was practically lost, operation should not be delayed. This should consist of a free excision of the head and neck.

Mr. Max Page

said that he felt there were no points in Mr. Buxton's opening paper with which he disagreed in principle. In his opinion, the outline set before them represented throughout a sound common-sense view of the present position in relation to the subject.

He thought that it was an extremely good thing that Mr. Buxton had emphasized the value of voluntary finger movements as a means of maintaining the condition of the forearm muscles during the splintage of this area. He had always been struck with the satisfactory way in which muscle condition was maintained by this means during the prolonged period of splintage necessary after the application of bone grafts to the radius and ulna.

Rare as its incidence might be, he did not think that too great emphasis could be laid upon the risk of the development of Volkmann's contracture after fractures; whether of the forearm or about the elbow; he could not agree with Mr. Fairbank's view that the condition was due rather to pressure on the vessels by bone fragments than to that caused by the bandages. He felt sure that in the majority of cases the surgeon who applied the splint, or failed to relax bandages in time, ought to accept the responsibility for the condition.

In regard to the question of open operation for fractures on the shafts of the radius and ulna, he agreed that the most satisfactory results as regards union were obtained in those cases in which no internal splintage was employed. There were, however, cases in which some internal support was clearly necessary if subsequent displacement was to be avoided. He had a prejudice against the use of plates, although he had seldom employed them in this field. He had seen delayed union and non-union result in many cases of plated forearm fractures; in several of these secondary deformities had developed. He had used beef-bone pegs as intermedullary dowels in a series of some twelve cases, and considered that, though not ideal, they had some advantages over metal plates. He showed a series of X-ray photographs demonstrating the history of bone pegs employed in this way. It would be seen from these X-ray photographs that there was a good deal of new periosteal bone formed about the peg, especially on the side opposite to that of the operative attack. The time taken for the complete absorption of the beef bone impacted in human limbs varied in individuals and also in relation to different bones. A peg about ¼ in. in diameter was absorbed in from nine to eighteen months. Sound union had resulted in all cases in which he had inserted such pegs, but not as rapidly as when simple impaction of the bones had been effected. This point was clearly shown by X-ray photographs of cases in which, after both bones had been fractured, one had been pegged and the other simply co-apted without internal splintage. In one instance he had observed late fracture of a peg which allowed secondary displacement to occur.

In his opinion the autogenous graft was probably the best method of securing co-aptation when internal splintage was necessary. He thought the most satisfactory graft for the purpose was a slip of bone taken from the tibia.

Mr. Paul Bernard Roth.

I have found that fractures of the shafts of these bones need a great deal of care. In treating them I have been guided by two rules: (1) Replace fragments if displaced, even if this requires an open operation (this is applicable to fractures of all long bones); and (2) treat the forearm in the position of full supination, regardless of where the fracture may be situated.

I propose to refer to a few special points. Thus, where both bones are fractured, and there is overlapping of the radial and of the ulnar fragments, an open operation will always be necessary to reduce the overlapping and to obtain good alignment and good functional result. The operation will consist in exposing the fragments subperiosteally, grasping them with Lane's bone-holding forceps, guiding them into position and keeping them there with a small Lane's plate, which must have at least *four* screws. If only two screws were used, one in each fragment, displacement recurred; and the same catastrophe followed attempts to fix the ends together with silver wire.

It is not always necessary to plate both the radius and the ulna; I prefer to plate the bone whose fragments are most displaced. Where only one bone is broken, and there is displacement, manipulation under an anæsthetic might reduce, as in a case of fracture-dislocation of the lower third of the radius, which I have previously shown to the Section.[1] When reduction does not take place, open operation must be done; but it is seldom necessary to apply a plate. When the fragments are cleared, they can be made to slip back into line with a snap, the remaining sound bone acting as a spring, and once the fragments are in position retaining them there. I name these fractures "*safety-pin fractures*."

For maintaining the supinated position I found that plaster gives the least trouble, and have never noticed displacement occur while it is being applied, as described by Dr. Mennell. I encourage the patient to start finger movements on the day following the operation. When the fragments have been plated, I do not use splint or plaster, only a sling, instructing the patient to keep his hand twisted round so that he cannot look at its palm.

Greenstick fractures require treating with much respect: relapse is frequent, and angulation, after quite careful treatment, common. I am in favour of completing the fracture under anæsthesia, and slightly over-correcting. Splints must not be laid aside for three or four weeks.

Finally, operation, if done, should be performed as soon as possible, the day of the accident for preference. After two weeks it is much more difficult to get a perfect result, and in some cases after this lapse of time it may be better not to operate at all.

In fractures of the neck of the radius, with dislocation of the whole head, I always remove the latter. When the head has been fractured in two, and one portion left *in situ* in the joint, I excise both fragments: I have found that when I leave a portion, there is limitation of movement subsequently. I have been surprised to find how well patients get on without the head of the radius.

Mr. Jenner Verrall

said that for purposes of internal fixation of the bones of the forearm, he was in the habit of using sliding bone-grafts, the side of the bone on which these were placed being determined by the tendency to angulation at the site of fracture. In his opinion these grafts were better than the introduction of any foreign body.

[1] *Proceedings*, 1923-24, xvii (Sect. Orth.), p. 10.

Mr. A. S. Blundell Bankart (President)

said he wondered whether the better results that were obtained after late, as compared with early, operation in fractures of the head of the radius, were not due to the fact that more bone was removed in the late operations. In fractures of the shafts he concluded that the majority of the speakers favoured plaster of Paris as the method of fixation after reduction, and open operation as the means of reduction in overlapping fractures which could not be reduced by manipulation.

It had been said that transverse fractures of the shafts could never be reduced by manipulation alone. He disagreed with that. Traction was the only method of reduction that had been mentioned, and nothing had been said about angulation of the fragments, which was by far the best method, even in closed fractures. He divided fractures of the long bones into those that would hitch and those that would not. If the line of fracture was sufficiently transverse or irregular to enable one fragment to catch against the other, when they were brought end to end, then a good result could be obtained by closed reduction and fixation. If the fragments could not be retained thus in end-to-end apposition, one had to choose between open operation and recovery with deformity.

Mr. Buxton (in reply)

said that he considered the better results of late excision of the head of the radius instead of its early removal for comminuted fractures, were not due only to a greater amount of bone being removed, although it might be the tendency to remove less in the early operation. From examination of a number of X-ray photographs and from the findings at operation performed shortly after the injury, he thought that the new bone formed after the early operation, in the capsule especially, was an important factor in causing unsatisfactory results. It was extremely difficult to limit this, as it was almost impossible to remove all the small fragments of bone in the case of a comminuted fracture.

Section of Orthopædics.

President—Mr. A. S. Blundell Bankart, M.Ch.

A Case of Symmetrical Synovitis of Knees.

By W. Rowley Bristow, F.R.C.S.

The patient, a girl aged 6, has had swelling of both knees for two years. The condition has become neither better nor worse, and she has never complained of pain. Her general health has been good; she has not been out of England, and there is nothing in the family or past history to throw light on the cause.

She first came under observation in September, 1925, when both knees were very much swollen, but painless. The synovial membrane appeared to be thickened and there was fluid in both joints, but more marked in the right; movement was free, extension being full and flexion almost full. The wrists showed a similar swelling on the dorsum and there was some swelling of the ankles, but the movements in both these joints were free and controlled. No changes in any of the bones or joints were shown by the skiagrams.

The child was transferred to our country hospital in the same condition as on admission.

Whilst there the child was treated with mercurial inunctions, until she developed a stomatitis, with no improvement in the knees. She was at first kept in bed, but the condition remained the same. After three months she was allowed to run about freely without the knees getting either better or worse. Her temperature was normal during the whole of her stay at Pyrford.

On January 25, 1926, the right knee-joint was opened and a portion of synovial membrane and some of the fluid were removed for pathological investigation. The fluid was turbid and the synovial membrane appeared somewhat thickened, red and injected. A few flakes of yellowish lymph were seen on the synovial membrane; these were easily removable.

Pathological Findings by John F. Taylor, M.D.

September, 1925.—Wassermann reaction and Sachs-Georgi flocculation test (on blood) both negative. Fluid from joint sterile when cultivated on various media. Blood-count: red cells, 5,560,000; hæmoglobin, 74 per cent.; leucocytes, 10,300; polymorphs, 51·5; lymphocytes, 40 per cent. Von Pirquet's test: bovine +, human −, control −. Urine, normal.

January, 1926.—Wassermann and Sachs-Georgi reactions, on blood and joint fluid, negative. Gonococcal complement-deviation test on blood and joint fluid negative. Fluid from joint showed a preponderance of polymorphonuclear cells, only a few lymphocytes and endothelial cells being present. Smear from lymph showed polymorphs, endothelial cells and marked fibrin formation; in one of these films a very few Gram-positive cocci were seen.

Cultivation of 2 c.c. of fluid yielded one colony of *Staphylococcus aureus*.

A fragment of lymph was placed between the thigh muscles of a guinea-pig; a week later no suppuration was present, and cultures from the surrounding tissues were sterile. One cubic centimetre of the joint fluid was injected into the peritoneum of another guinea-pig. (This was killed after three weeks, no sign of disease found; cultures from peritoneal cavity were sterile.)

Blood-count again showed a leucocytosis—total white cells, 14,700; polymorphs, 56·3; lymphocytes, 35·3 per cent.

Examination of the fæces on two occasions revealed no abnormal organisms.

Sections of the synovial membrane showed many foci of lymphoid, plasma and endothelial cells, particularly beneath the endothelium. Congestion of vessels, some blood-pigment. Areas of fibrosis Attached to the endothelium small patches of inflammatory exudate containing a few polymorphs. No bacteria seen.

The interpretation of these findings leads to the conclusion that syphilis gonorrhœa and tuberculosis can be excluded as causes of the condition, not only by reason of the negative results of specific tests for these diseases, but also from the presence of leucocytosis and the microscopical examination of the fluid and synovium. The presence of a single colony of *Staphylococcus aureus* in culture of the fluid is not of great significance, but this organism is unusual as a contamination.

The lesions are evidently due to a general infective process of which the exact cause remains "not proven."

Case of "Scaphoid" Scapulæ.

By PAUL BERNARD ROTH, F.R.C.S.

F. T., AGED 12, has been under treatment since March, 1925, for scoliosis, stoop, and general weakness. The vertebral borders of her scapulæ are markedly concave, constituting a condition known as "scaphoid" scapula, which has been exhaustively described by Dr. W. Washington Graves (see *Archives of Internal Medicine*, 1924). Dr. Graves supposes it to be a sign of "inborn unduly-disease-susceptible soil." This particular patient is the third child; the first was still-born, due to delay caused by a transverse presentation; the second, her brother, aged 22, has always been delicate, but earns his living. Her grandfather (father's father) died of consumption, as did also two of his brothers.

Case of Fibrous Ankylosis of the Knee, treated successfully by Manipulation.

By PAUL BERNARD ROTH, F.R.C.S.

R. M., a WAITRESS, aged 22, was admitted to a medical ward on January 1, 1925, with an acutely painful and swollen right knee.

She stated that a month previously she had had an attack of vomiting, and two days later had experienced a sharp pain in the right knee, which became very swollen.

On admission she appeared to be suffering from an acute arthritis of the knee, and had a raised temperature, 99° to 103° F., for ten days. Extension was applied, which relieved the pain; the temperature and acute symptoms gradually subsided, a completely stiff knee being left.

I was asked to see her on March 13, and after a radiogram had been taken which showed considerable absorption of articular cartilage, especially in the outer half of the joint, I gave a bad prognosis as regards her ever obtaining a movable knee. The knee was quite stiff in full extension.

The following notes describe her case:—

May 12.—Sent to Eastbourne: knee quite stiff.

June 12.—Returned: knee still quite stiff.

July 10.—Can flex to 160°: that is, 20° of movement.

September 11.—No improvement: the amount of movement possible is of no use to her. Manipulation advised.

September 16.—*Anæsthetic;* soft adhesions broken down: knee flexed to 135°.

October 7.—*Anæsthetic;* more soft adhesions broken down: knee flexed to 105°.

November 4.—*Anæsthetic;* knee flexed to 90°.

December 2.—*Anæsthetic;* knee flexed to 80°.

January 8, 1926.—Can now flex knee to 80° herself.

January 29.—Radiogram shows knee nearly normal with apparent regeneration of cartilage.

Comment.—This knee was regarded in hospital as probably of gonococcal origin, but examinations of vaginal swabs were always negative.

After each manipulation there was considerable reaction, which quieted down, however, after a few days' rest. The next manipulation was not carried out until all signs of reaction caused by the previous one had completely subsided.

The patient can now walk without a limp, and without being conscious of any trouble in her knee.

Bilateral Os Tibiale Externum, with Unilateral Hypertrophy of the Navicular.

By E. Laming Evans, C.B.E., F.R.C.S.

D. M., FEMALE, aged 22, presented herself at hospital on December 28, 1925, complaining of a painful swelling on the inner side of the left foot. A painless swelling had been noticed since childhood; but during the last two years the swelling had become larger and painful.

Examination showed a swelling, the size of a walnut, in the left navicular region of bony consistence covered by a soft bursal swelling and reddened skin. The bony swelling consisted of two parts, which were slightly movable one upon the other.

On the right side there was no undue prominence in the navicular region, though a slight movement of the tubercle upon the body of the scaphoid could be detected. X-ray examination showed a condition of bilateral os tibiale externum with hypertrophy of the body of the scaphoid on the left side only. Removal of the hypertrophied portion of the navicular together with the os tibiale externum on the left side had been recommended.

Postscript.—This was carried out on February 5.

A Case of True Congenital Hypertrophy of the Left Lower Limb.

By A. Rocyn Jones, F.R.C.S.

E. F., a GIRL aged 10, came to hospital on February 5, 1920. She complained only of limping and of a sensation of undue weight in the left leg. She had never had a serious illness. When a baby, her left leg was bigger than it should be. On examination the whole left lower extremity appeared much larger than the right, but considered by itself a proper balance was preserved between the size of its component parts. There was no sign of paralysis or of muscular weakness. The calf and thigh were considerably greater in girth than the corresponding parts on the right side, but the only measurement recorded was the length of the limb, which was 1¼ in. longer than its fellow. The foot was broad and flat, with a separation between the first and second toes. Radiograms showed general enlargement of the bones of the foot and of the leg, but not quite as much as one would expect from the bulk of the

soft tissues. The sella turcica was unaltered. Apart from the limp the child walked well, and was healthy in every way. She was fitted with a right boot having three-quarters of an inch of cork to compensate for the shortening, and a left boot with instep support, valgus wedge and prolonged heel. The girl has been under observation for the last six years, and the striking contrast first observed between the two limbs has been maintained, but the overgrowth is not progressive. At present the measurements are as follows :—

	Right	Left
1. Ant. sup. iliac spine to int. malleolus ...	32½ inches	33½ inches
2. Circumference of thigh	16½ ,,	17½ ,,
3. Circumference of calf	12½ ,,	14½ ,,
4. Circumference of foot at heads of metatarsals	9 ,,	10 ,,
5. Heel to tip to third toe	9¼ ,,	9¾ ,,

Lately 3 in. of genu valgum has developed at the left knee, and the second digit has contracted to a hammer-toe. There is an absence of nævi, which are commonly present in these cases, but there are a few round scars on the leg. The Wassermann test is negative. There is no family history of deformity or anything to suggest a hereditary bias.

Congenital hypertrophy is conveniently divided into two groups, the *true* and the *false*.

(1) *True Congenital Hypertrophy.*—This occurs when all the tissues of the limb, or part of a limb, are increased and where no particular tissue is excessively proliferated. These true hypertrophies are always congenital and as a rule are not progressive; the function of the part is not impaired, in fact the limb is usually stronger. The most extensive and typical example of true hypertrophy occurs when the whole of one side of the body is affected. Forty-one such cases of hemi-hypertrophy have been reported. Again, one limb only may be affected, or both lower limbs or both upper, or one upper limb and the opposite lower limb may be involved, forming a crossed quarter hypertrophy. Although the symmetry of the part is on the whole well preserved there is a tendency for the more distal parts to be more affected, i.e., the foot suffers more from overgrowth than the leg, and the leg than the thigh.

About the pathology of the condition nothing is known. A lesion of the pituitary body was suggested but no disease or increase of this organ has ever been found.

(2) *False Hypertrophy.*—This may or may not be congenital. The symmetry of the limb is rarely preserved, deformities are frequent and function is invariably impaired. One tissue is usually predominantly and progressively proliferated, e.g., neuro-fibromatosis, lymphangiectasis and diffuse lipomata are common causes of false hypertrophy.

The case shown represents a true congenital hypertrophy. The overgrowth dates from birth, all the tissues participate, the symmetry of the limb is preserved, function is unimpaired and the overgrowth is not progressive.

Case of Generalized Fibrocystic Disease of the Bones.

By R. C. Elmslie, O.B.E., M.S.

V. M., married woman, aged 37, had a fracture of the right arm three and a half years ago. She is said to have recovered from this and to have regained the use of the arm. In July, 1924, she had an attack of neuritis in the left upper arm, which was gradually improving in September, 1924, when a similar attack of pain came on in the right upper limb, and the patient one day discovered that this arm had re-broken at, she believed, the site of the old fracture.

December 10, 1924.—There was a flail pseudo-arthrosis in the lower part of the right humerus with much pain on movement; no enlargement of the bone. The patient was a rather frail looking woman, but otherwise presented no evidence of disease.

On X-ray examination it was found that the shaft of the right humerus was missing for about 2 in. in its lower one-third, the ends being cup-shaped as if the absent part was represented by a cyst or new growth. Higher up in the bone was a second cavity of large size, again with cup-shaped extremities. A similar large cavity was found in the upper end of the left humerus, and others were found in the upper end of the left radius, in two situations in the left femur and in two situations in the right tibia. Later, X-rays showed further cavities in the ilium on both sides.

An incision made over one of the tibial swellings showed that it was a simple cyst, filled with fluid, lined with smooth bone, and a portion of the wall removed showed no evidence of new growth.

January 7, 1925.—The cystic cavities in the upper and lower part of the right humerus were opened and curetted. They were formed of a thin, smooth wall of apparently fibrous tissue and contained brown fluid under tension. No solid material at all could be obtained from the lower cavity; some very small fragments were curetted from the extremities of the upper cavity. On microscopic examination the latter fragments showed fibrous tissue arranged in bundles and leaving regularly defined areas as cavities. It is suggested that these spaces had been occupied by crystals or by blood débris. There was no evidence of any new growth. The arm was fixed in plaster and later in a leather splint.

April 3, 1925.—The arm was clinically united, with slight deformity at the point of each cyst; a radiograph showed the cystic regions occupied by new bone.

Later radiographs taken in April, 1925, and January, 1926, show the following changes in the cysts:—

April, 1925.—Those in the right humerus are completely replaced by new bone, and the remainder of the shaft of the bone is much denser than before.

The cyst of the left humerus has at some time been fractured through its lower extremity; the cavity is smaller and much more solid.

The cyst in the left radius has increased a little in size by extension down the shaft.

The cysts of the left femur have both increased in size, and a new cavity is evident in the trochanter, and is increasing.

January, 1926.—Cavitation in the middle of the shaft of the right femur.

In the right tibia the upper cyst has diminished in size, and the bone around is denser; the lower cavity has increased.

The cavities in the pelvis have not altered.

The skull shows a general thickening of the whole calvarium; the bone is mottled throughout, and a cavity appears to be present behind the frontal sinuses and to be increasing in size.

In the last radiographs some cavities can be detected in the ribs.

It appears that in the case of cysts damaged by operation or by fracture there is a tendency towards cure; some at least of the others have steadily enlarged. On the basis of these observations it is suggested that the correct treatment is to open or to puncture every cavity which is enlarging and which might cause disability, if fracture takes place.

The case seems to be one of true, generalized, cystic disease of the bones, such as was originally described by von Recklinghausen. So far no pathological investigations have done anything towards eliciting the cause. The Wassermann reaction is negative; the blood-count not evidently abnormal; the calcium content of the blood and the calcium excretion are within normal limits; the urine contains no Bence Jones protein; microscopic investigation has failed to reveal anything.

FIG. 1.

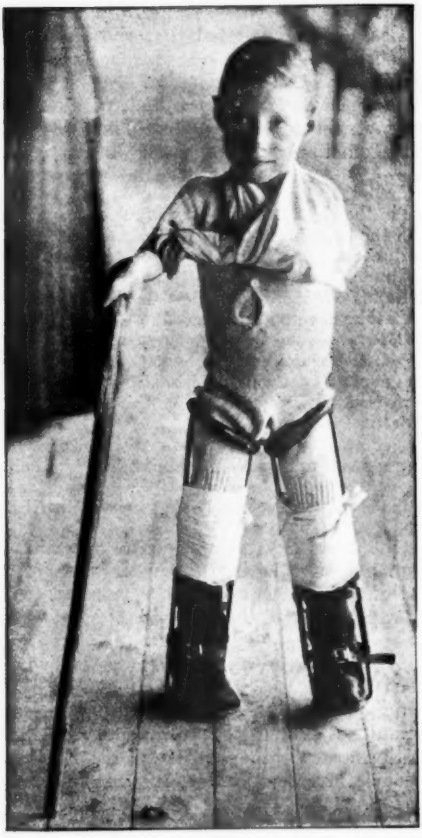


FIG. 2.

Case of Multiple Deformities.

By D. McCrae Aitken, F.R.C.S.

TWICE previously shown to the Society, first in 1923, when he was only able to crawl on hands and knees (see fig. 1, p. 36) with callosities on the dorsums of the hands on which he walked, owing to extreme pronation of the forearms. The photographs exhibited show the various stages of progress up to the present day. He can now walk erect, the right arm and hand are free for exercise, the left arm and hand are still under correction in splints (see fig. 1).

Case of Bow Legs.

By D. McCrae Aitken, F.R.C.S.

T. H., BOY, aged 4, first seen when 18 months old; since then he has remained small and stunted. Urine shows 2 per cent. of urea and there is no suggestion of renal insufficiency. *Bow legs*, frontal bosses, but the arms and ribs do not show pronounced signs of rickets. The wrists are slightly thickened. With regard to the bow legs there is an unusual sharp bow of the extreme end of the tibia; this I show because I cannot remember anything quite like it before.

Case of Tuberculous Disease of the Sacro-iliac Joint.

By H. A. T. Fairbank, D.S.O., M.S.

W. P., MALE, aged 39.

January 20, 1926.—Pains in back seven years ago. Attended various hospitals. Was put in plaster for three months. Abscess burst in lumbar region. In Lewisham Hospital a year, and abscess opened in left iliac fossa. The posterior sinus closed; anterior still discharging. Some months ago a piece of bone worked out from anterior sinus. Probe can be passed for 2½ in. No pain on walking. No definite clinical sign of activity in sacro-iliac region. He is at work as a clerk and able to get about without discomfort.

The following note has been forwarded from the Mildmay Hospital: "Sinus in left groin was explored on April 22, 1922, the probe passing backwards and bare bone felt. Sinus was opened up, and left sacro-iliac joint explored from the back, no necrosis being found."

X-ray examination shows clear areas on either side of left sacro-iliac joint surrounded by dense bone, as if the disease was quiescent and possibly cured to a very large extent, if not entirely. Except for the presence of a sinus in the groin his disease appears to be healed. As this sinus will persist if nothing is done to remove the small focus of disease which must be present, it is proposed to excise the joint from the back by Picqué's method as the only means of reaching the disease.,

Mr. A. Blundell Bankart (President) expressed entire agreement with the proposed operation. The results were satisfactory and not nearly so depressing as was generally held to be the case.

A Case requiring Skin-grafting was shown by Dr. W. T. Gordon Pugh, who asked for opinions as to method of grafting.

Section of Orthopædics.

President—Mr. A. S. Blundell Bankart, M.Ch.

DISCUSSION ON THE LATE RESULTS OF OPERATION FOR CHRONIC PAINFUL HIP.

Mr. C. M. Page, D.S.O.

At first sight the title of this discussion strikes one as somewhat latitudinarian and even unscientific. When, however, one considers the limitations and vagueness of our knowledge of the several pathological changes which may cause chronic pain in the hip-joint, it must be allowed that an indefinite title is in some measure justifiable.

I do not propose, however, to include any consideration of tuberculous infection of the joint, although cases of this nature would come under the category of chronic painful hip. The omission of these conditions is desirable, I think, as the infective factor in them assumes an importance, in relation to operation and its results, which is not present in other forms of chronic arthritis. For similar reasons, and on account of its rarity, I shall not discuss syphilitic arthritis.

For practical purposes this leaves for consideration the late results of cases of chronic arthritis of the hip-joint of a kind which will fall under one of the three following headings, viz. :—

(1) Primary monarticular osteo-arthritis. (Hypertrophic and atropic forms.)

(2) Chronic arthritis secondary to fracture of the neck of the femur or of the acetabulum.

(3) Polyarticular arthritis involving the hip. (Including rheumatoid arthritis and borderline cases.)

Any discussion as to the class of case suited to operation does not come under consideration ; I will therefore proceed to classify the operative procedures which may be employed in these cases, and indicate the results which have been recorded in relation to them. I will terminate by giving my own personal experience in a limited group.

Four operative procedures are sufficiently well recognized to merit consideration, viz. : (1) Arthrodesis of the hip-joint. (2) Excision of the head of the femur. (3) Cheilotomy. (4) Arthroplasty.

The choice of operation for this joint is less dependent on the anatomical condition of the joint or on ætiology than on the age and general condition of the patient. In the young and middle-aged the aim should be not only to remove pain, but to provide a stable joint. This can be most effectually done by providing bony ankylosis at the joint line. An arthrodesis is most certainly produced by a complete erasion of the joint, followed by fixation in plaster-of-Paris, in the position of election, for a sufficient time to allow bony union to occur. This procedure was first advocated by Albee in 1908 [3]. In his early series he merely "rawed" the upper surface of the femur and corresponding aspect of the acetabulum. Latterly he has adopted a more thorough exposure of the joint, and further ensures bony ankylosis by the insertion of an autogenous bone graft. In the series of cases, the results of which I report later, I have usually dislocated the head of the femur and carried out an erasion of the joint.

The operation must be regarded as a severe one, though in my experience it is not associated with much shock. It is the prolonged after-fixation in plaster-of-Paris in the recumbent position which is found most trying by the patient. The functional results of a fixed hip in a satisfactory position are remarkably good in, as a rule, the younger subjects. The most serious disability noticed by the patient is, as a rule, the difficulty he experiences in doing up his boot on the affected side.

In reviewing the later results it is noticeable that elderly subjects sometimes develop pain in the lumbar spine and sacro-iliac joints after an arthrodesis of the hip. The fixation of the hip undoubtedly imposes a serious strain on these joints. I have noticed that pain of this character is most prominent in the first year or two after operation, and generally diminishes rather than increases later.

In elderly, feeble patients an arthrodesis is not usually attempted. A simple excision of the head of the femur has been most often favoured. Sir Robert Jones [9] advises the production of a pseudo-arthrosis at the base of the neck of the femur without touching the diseased joint. Both these latter operations relieve pain, but leave a joint of poor stability, so that the patient is left dependent on the use of crutches or a walking caliper.

The more conservative procedure of cheilotomy (Sampson Handley) is suited to but few cases, and it cannot be expected to effect a lasting cure.

Platt advocates a partial excision at the head of the femur, leaving sufficient bone to engage the upper rim of the acetabulum. This leaves, in favourable cases, a stable joint with fair mobility.

In my own experience the operation of erasion of the joint has been well tolerated by old patients, and I have merely varied the after-treatment in their cases by making no attempt at rigid fixation in plaster-of-Paris. A painless fibrous ankylosis or pseudo-arthrosis is in this way obtained in a relatively short time; the hip is stable, but there is a tendency to the development of an adduction deformity.

The performance of a formal arthroplasty in the case of the hip-joint is a procedure of doubtful policy, and is hardly necessary in cases of osteo-arthritis. As stated above, a useful range of movement at the hip is obtained by an erasion or partial excision of the joint, followed by suitable after-treatment. Indeed, it is not easy to secure a sound bony ankylosis at the hip-joint, as is made clear by the results seen in Table I (p. 42). This experience falls into line with the frequency with which a pseudo-arthrosis is formed after an unimpacted intracapsular fracture of the neck of the femur. This suppression of new bone formation within the joint may be attributed to the exposure of the broken surfaces to the influence of synovial fluid; the same condition prevails after an erasion or excision of the hip for a non-inflammatory condition.

In examining the later results (Table I) of cases of operation on the hip-joint, the tendency to the development of an adduction deformity is striking. This deformity results in serious functional shortening of the limb, from tilting of the pelvis when the erect attitude is assumed. As it is manifestly a complication to be avoided it is worth while to examine the factors which are responsible for its production.

Adduction deformity is a notable feature in any case of destructive disease of the hip-joint. It appears to be due to at least two causes: (1) the proportionately excessive wasting of the gluteal muscles, which lie in intimate relation to the joint; the adductors, which are normally the master group, are at a greater distance from the articulation and do not suffer so severely. (2) The abducting power of the glutei and tensor fasciæ femoris is reduced by the shortening of the lever (the neck of the femur) through which they act. Both these factors are operative in some degree after the operation under consideration. First, the muscles may be mechanically damaged or the nerve-supply interfered with if the incision is not carefully planned; secondly, any considerable removal of bone from the head of the femur, or unusual deepening of the acetabulum, will shorten the lever through which the muscles act.

The problem of avoiding the secondary development of adduction after operation only arises when a fibrous joint is the result. If firm bony ankylosis is obtained in a good position by means of proper fixation, the difficulty does not arise; but it should be remembered that sound bony union is not always obtained, however carefully the operation may be carried out, and that union, apparently firm, if due to fibrous tissue, is liable to gradual stretching.

Therefore, in all operations of this nature the two simple mechanical factors above enunciated should receive attention, viz., (1) preservation of the full function of the gluteus medius and minimus and tensor fasciæ femoris, and (2) the preservation of the neck of the femur at as full length as possible. In practice the adductors may be weakened by section of their tendons, followed by forced abduction of the thigh. To correct the result of shortening of the neck of the femur, Whitman advocates the re-implantation of the bony insertion of the gluteus medius and minimus into the shaft of the femur a couple of inches below the normal position of the great trochanter. I have no experience of this procedure, but it seems to be based on sound lines.

When one comes to estimate the value of late results of these various operations the view of the patient and that of the surgeon differ somewhat. The former is well satisfied if he loses his pain and is left with a limb the functional value of which is not worse than before operation. The surgeon, on the other hand, recognizes that the removal of the pain is readily effected and looks rather for an improvement in the functional value of the limb. In either case, the true merit of the procedure can only be fairly assessed by a study of the results some years after operation. This particularly applies if operation is undertaken during the active period of the patient's life, when the resulting function of the limb is almost as important as the relief of pain.

The evidence in the literature on the subject is somewhat meagre, only a few authors having published the details of the late results of any considerable number of cases. The outcome of operations aiming at arthrodesis has received the most attention.

Ozarki [5] in 1917 records the results of the arthrodesing operation of the hip in ten cases of polyarticular arthritis and sixteen of the monarticular variety. The same cases were reported on a few years later.

In 1920, Spiers [6] in a careful survey of the late results of all the cases operated on between 1908 and 1920 at Brackett's clinic, sets them out in tabular form as follows:—

Cases operated on	34
Cases examined later and reported ...	25
Average age	years 46
Youngest	,, 22
Oldest	,, 61
Case mortality	2
Average interval since operation	years 4½

RESULTS OF EXAMINATION.

Union: Union firm ...	17	*Position:* Adduction present in ...	18
,, questionable	3	Normal	4
Non-union ...	5	Abduction present in ...	3

He found that in the cases unrelieved by operation, arthrodesis had not been secured.

Albee in 1921 [3] reported that he had operated on 128 cases with satisfactory results. Details of these cases in regard to the technique of operation and the late results are not published.

The results of the operation of excision of the head of the femur for this condition have not been reported in any large series. Individual experience appears to vary. Pain is relieved in all cases, but the functional value of the joint is reported upon as a whole unfavourably, considerable shortening being the rule, and stability uncertain. (Fock, Zezas, Müller and Hoffa [2] [7]).

Platt has reported to me that he has carried out a modified excision in some twenty cases. He considers that though pain is thereby relieved, the average function given by this operation is disappointing.

Turning now to my personal experience, I have operated on fifty-seven cases of chronic arthritis of the hip from 1919 to date. An analysis of the earlier cases was published in a Hunterian Lecture in 1924 [1]. The following figures form an amplification of those detailed on that occasion.

The series is made up of the following types: Monarticular osteo-arthritis, forty-eight; polyarticular osteo-arthritis, two; traumatic osteo-arthritis, seven.

In the forty-eight cases operated on for chronic arthritis, an erasion of the joint was effected in forty-seven by one of the methods previously described. After-treatment was carried out with a view to obtaining bony ankylosis in thirty-eight cases, and a fibrous joint in ten. Eleven of these cases were operated on in 1925, and therefore are of no value in assessing the late results.

Table I gives in outline the late reports of the forty-six cases in which operation was carried out between January, 1919, and January, 1925. The average age of the patients in these cases was 47·5, the oldest was 73 and the youngest 24. The results tabulated were obtained by clinical and X-ray examination made at least a year after operation. The reports on six of these cases are not recent, as I have lost touch with the patients. Two patients have died a year or more after operation. The statements in regard to the absence of pain are based on the patient's opinion, and refer to the original joint pain. The term "slight pain" is applied to those cases in which complaint was made of ill-defined pain in the groin or thigh after fixation. The estimate of the functional value of the limb is necessarily approximate. No hard-and-fast classification is possible when dealing with the condition, the results varying in relation to the age of the patient and the preceding period and degree of disability. The term "good" has been applied when the patient could walk about five miles without any support and do a fair day's work. "Fair" implies the ability to walk about two miles and to stand about half an hour without fatigue. The term "poor" is applied to those cases in which the ability to walk was limited to a mile or less.

The number of these cases complaining of pain in the sacro-iliac joints or lumbar spine is difficult to determine. Most of the female cases have complained of such pain in the relatively early post-operative period. It would appear that the pain passes off or is tolerated after a year or so. On the other hand, none of my cases have been under observation for more than six years, and so one cannot accept this evidence as in any way final.

TOTAL NUMBER OF CASES TO JANUARY, 1926, FIFTY-SEVEN.

TABLE I.—FORTY-SIX CASES OPERATED ON AT LEAST A YEAR AGO.

Condition of joint		Position		Pain in hip		Function short		Function value
Bony ankylosis 26	...	Normal ... 8	...	Absent 38	...	Average	...	Good 28
? ,, 7	...	Adduction 35	...	Slight 8	...	1·3	...	Fair 13
Fibrous Joint 13	...	Abduction 3	...	—	...	—	...	Poor 5

As might be expected the functional results are most often satisfactory in the younger patients, as is shown in the following table:—

TABLE II.—FUNCTIONAL RESULTS IN REGARD TO AGE. FORTY-SIX CASES.

Age 20 to 49				Age 50 to 75			
Cases	Good	Fair	Poor	Cases	Good	Fair	Poor
22	18	4	*nil*	24	13	7	4

The relation of fixation to function is shown in the following extract:—

TABLE III.—RELATION OF FIXATION TO FUNCTION. FORTY-SIX CASES.

Condition of joint	Cases	Good	Fair	Poor
Ankylosis ...	26	24	2	—
? Ankylosis ...	7	4	3	—
Fibrous joint	13	3	6	4

In the six cases in which the head of the femur was excised on account of a painful ununited fracture of the neck, an attempt was made to effect an arthrodesis. In three cases a beef-bone peg was employed, and in the other two no special means of internal fixation were employed. In the first three cases arthrodesis resulted, and in the other three a mobile and fairly stable joint was the result.

I have carried out an arthroplasty in three cases, in two of which both hips were affected. Relief of pain followed in two cases, but the functional results were only moderate. In the other, a woman aged 65, the result was poor both as regards pain and function. I have no personal experience of the results of the operation of cheilotomy.

This brief survey may, I fear, have given rather an unbalanced view of the subject. I have intentionally spent most time on the consideration of arthrodesis, being convinced that it gives, on the whole, the most satisfactory results in those cases in which operation is called for.

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Mr. R. C. Elmslie, O.B.E.

said he thought the cases might well be divided into those in comparatively young people, in whom there was often a particular existing anatomical abnormality of the joint (such as coxa plana or coxa vara), the monarticular osteo-arthritis of elderly people, bilateral cases (including cases of spondylose rhizomélique), and old ununited intracapsular fractures. The operations possible were arthodesis, arthroplasty, Jones's operation of resection of the neck and pegging of the trochanter on to the head, excision of the head, with or without lowering the great trochanter, and the so-called operation of cheilotomy. In judging of the results of these operations, the one criterion should be the relief of pain. The operations were done for this purpose, and unless pain was relieved they were a failure. Judged by this standard arthrodesis was undoubtedly the most successful operation, and was to be recommended as a routine in monarticular cases, both in the young and in the old. The results of arthroplasty were disappointing. Too often the hip stiffened up again, and in a large proportion of cases more or less pain persisted, unless the arthroplasty failed and the joint became fixed. Naturally, the bilateral cases led one to try an arthroplasty, but unfortunately these were particularly the cases in which it was apt to fail and to leave a painful hip, probably because there was a continuing arthritis of the joint.

The best result that he (Mr. Elmslie) had seen in spondylose rhizomélique was in the case of a man whose hips had become ankylosed in a position of about 40° flexion with slight abduction, permitting the man to sit comfortably and also to walk from the knees.

Excision was the best operation for ununited intracapsular fracture in which pain was present, and if the trochanter were lowered, a certain amount of stability could be secured.

Cheilotomy had given successful results, at any rate for a few years, in young adults with a deformed head of the femur resulting from old coxa plana.

In carrying out an arthrodesis he (the speaker) advocated a posterior approach, and dislocation of the head of the femur, which was then peeled and placed against

the raw surface of the roof of the acetabulum. The adductors should be divided at the operation to prevent recurrence of the adduction deformity, and after four or five weeks the patient should be encouraged to walk, with weight on the limb, in a short plaster spica.

Mr. W. Rowley Bristow.

This discussion is limited to the late results of operation for chronic painful hip, and the results of two operative procedures will be considered, viz., arthrodesis, and a reconstruction of the joint. I do not think the so-called cheilotomy operation can often be called for in this connexion.

(1) *Arthrodesis* gives a good hip in young people, with a supple lumbar spine ; but must tend to throw increasing strain on this region with advancing years. It does relieve pain in the hip, but does it always relieve the lower "back-ache" pain? Again, in some patients both hips are affected and painful, and although I have come across patients who get on remarkably well with two fixed or nearly fixed hips, if one can relieve pain by an operation which allows of some movement in the joint, this is to be preferred. The results of arthrodesis are well known, and have been already

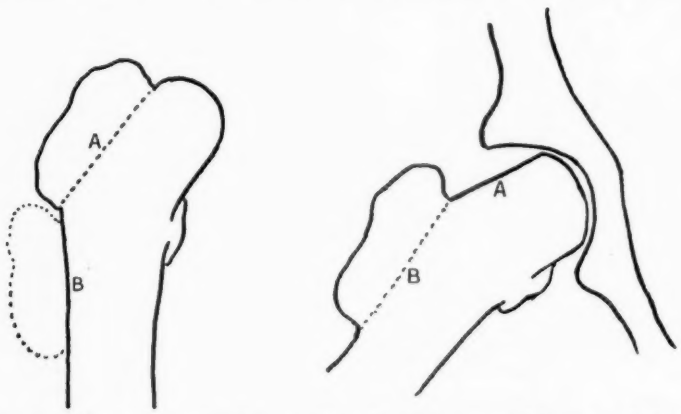

Fig. 1.—Whitman's reconstruction operation. Trochanter removed from A and placed at B, thereby converting A into a new femoral neck.

dealt with fully by Mr. Page in opening the discussion. I agree with him that the operation is generally successful, and has a very definite use.

Our contribution to the discussion is based on a consideration of the results of a reconstruction operation on nine patients with chronic painful hip.

(2) *Reconstruction of hip-joint.*—The reconstruction operation, as modified by Whitman, merits our careful consideration, and should receive a trial. Whitman published a short paper in the *Annals of Surgery*, November, 1924, and based his report on seven cases of arthritis deformans in which he had performed this operation. He had already, in 1921, used this method of lowering the trochanter in order to increase the power of abduction in patients with ununited fractures of the neck, in which he removed the head of the femur.

The operation consists essentially in free excision of the head of the femur, and lowering the trochanter, thus forming a new neck and giving a better leverage to the abductor muscles (fig. 1). There is a further advantage in that the lowering of the trochanter removes the block to abduction.

There is general agreement as to the need for free removal of bone in order to get a movable joint.

There are exceptional patients who seem unable to throw out bone, and in whom the end result of an attempted arthrodesis is a movable joint. It may be even a joint with free movement, but this is the exception and not the rule.

ROUTINE OPERATION AND AFTER-TREATMENT.

We open the hip by the U-shaped supero-external approach, and a cut running some four inches vertically downwards exposes the upper part of the femoral shaft. The trochanter is chiselled off, with its muscles attached, and the head, dislocated if possible, is freely excised, together with most of the neck. The remaining stump of the neck is rounded off with a file, no flap or fascia is interposed, and nothing is

FIG. 2.—Arthroplasty of right hip: trochanters not lowered, June, 1922.

done to the acetabulum. The trochanter is re-attached to the shaft, bared for its reception, as far down as possible, perhaps 1½ in. below the site of its former attachment. This is done with the limb in wide abduction, which is necessary in order to get it as low as possible. It is pegged into its new position.

The operation is not a long one, and the patient comes to the theatre with the strapping extensions already in place, so that as soon as the dressing is applied, all that remains is to slip on the Thomas's splint. Time and exposure are saved because the plaster spica is avoided.

Both limbs are slung in a Thomas's splint in wide abduction and full extension, and traction is applied. After fourteen days' rest, the patient is encouraged to move the limb by means of slings over pulleys. No forced movement is employed.

Splints are removed in six weeks, and for two weeks the patient is left free in bed.

At the end of the eighth week the patient is allowed up with crutches and a caliper. The caliper is discarded in from four to six months from the date of operation.

Results.

In the small series of cases which we are reporting we have not met with any complications, and the post-operative shock has been small. It has not been sufficient to call for the performance of transfusion on any occasion.

Fig. 3.—Whitman's reconstruction operation, performed March, 1925, X-ray taken December, 1925.

In the first operation reported, carried out in 1922, we did not lower the trochanter (fig. 2, p. 45). The operation resulted in a movable hip-joint and was fairly successful. The patient was suffering from a painful arthritis in both hips, and the operation was performed on the worse hip. She states that this is now better than in the hip not operated on, so much so that she is seeking re-admission for operation on the second hip.

One case resulted in failure. The pain was not relieved and all movement was limited by spasm. This patient is suffering from spondylitis deformans. Two years before we had treated her back, and at that time the hips were free from pain and had a good range of movement.

One hip became stiff and painful, and as arthrodesis was out of the question with a rigid spine we attempted to give her a movable hip. We realized at the time that she had arthritis that was progressive, but the only alternative was to condemn her to a bed-ridden existence, painful even under that circumstance. We have now performed a pseudarthrosis

in the upper third of the femur, in our efforts to get movement, but it is too early to judge of the result.

One patient has been operated upon within the last six months, so her case is too recent to be included, but she promises well; she is at present walking and is free from pain.

The other seven patients have been treated by a free excision of the head, and the formation of a new neck, with lowering of the trochanter.

One patient, Mrs. B., operated on a year ago, has been shown this evening (fig. 3, p. 46). She is pleased with the result and states that she can walk as far as she likes without any splint. She has a movable hip-joint, can flex 50°, and has some abduction and adduction. The movement is controlled. This woman before operation had a painful hip, fixed by spasm, which did not allow any movement. Further, it is fair to say that the controlled range of movement has increased during the last six months, and this is noticeable in all except two patients.

We have thought it best to make to this meeting what is an interim report of the results we have so far obtained, although we recognize the fact that the results we show are not necessarily the final end results. We feel that it would be better, if it be possible, to obtain a movable hip, free from pain, rather than a fixed hip, and that the reconstruction operation, as far as we have gone at present, is promising in its results.

Mr. Naughton Dunn.

The subject for discussion is the question of the operative treatment for painful chronic arthritis of the hip, but no mention has been made of the fact that the painful hip is frequently in a position of 60° to 90° flexion. This means that the length of the femur is acting as a lever, which very much increases the strain on the joint when weight is borne on the limb.

In many of these cases simple osteotomy, by correcting the alignment of the limb, will be sufficient to relieve pain. This is not a difficult operation, and it is one which I believe to be the operation of choice in young adults in whom pain is present only after prolonged use of the limb. In the majority of cases, however, something more radical is necessary, and my experience has been that the two most certain methods of relieving pain are, either arthrodesis of the joint, or the operation advised by Sir Robert Jones. Mr. Page's large series should be sufficient to satisfy us that pain can be relieved by arthrodesis of the joint in the large majority of cases, and I feel sure that the resulting adduction deformity in a large percentage of his cases could be almost eliminated, so that a more useful functional result would be obtained.

From my experience of all the operative procedures advised, I would at present pin my faith to arthrodesis of the joint for relief of persistent pain in cases of arthritis of one hip. Where operation is necessary both to ensure movement and to eliminate pain, as in some cases of arthritis of both hips, I prefer the operation practised by Sir Robert Jones. I quite realize the value of Whitman's operation in selected cases, but I am not yet satisfied that it is equally reliable for the subject we are discussing —the relief of pain.

Mr. H. A. T. Fairbank, D.S.O.

said he noticed that nothing had been said with regard to cases of congenital dislocation of the hip in which the patients were suffering an increasing amount of pain. He had recently seen two cases of this type in which he had excised the head of the femur about three years ago. In one there was a dry arthritis with atrophy of the synovial membrane, while in the other villous arthritis was present. In both the result might be regarded as satisfactory since they could walk three or four miles before getting tired, and were otherwise entirely free from pain. Another point not mentioned was Lorenz's bifurcation operation. Though he had found it satisfactory in cases of old arthritis—tuberculous and pyogenic—he had obtained no satisfaction from the procedure in the only instance of congenital dislocation in an adult woman in which he had tried it. After osteotomy he found it impossible to maintain

the fragments in the desired relation to each other. All he had achieved in this case was to produce some angular deformity at the site of the osteotomy and an increase in the shortening to a slight extent without materially relieving the pain. The mobility of the upper fragment in these cases seemed to cause the difficulty which was not experienced in the arthritis cases with a more or less ankylosed joint.

Mr. G. R. GIRDLESTONE.

There is a certain group of cases in which the one supremely important object is to ensure *permanently free mobility* in the hip. The best example is that of the man with spondylitis deformans in which the spine and both hips are stiff. Another is the exceptional case of a painful hip with very limited movement in a man who has always worked at a sedentary occupation.

The former type of case is prone to ankylosis, even after the Robert Jones pseudarthrosis operation. Having experienced this I have devised a new method, and have used it in four cases with complete success.

The steps of the operation are the following:—

(1) Incision, usually the anterior Smith-Petersen method. If an external transverse incision is made, steps 3 and 4 precede step 2.

(2) Two fibro-periosteal flaps, anterior and posterior, are reflected upwards and inwards from the anterior and posterior inter-trochanteric lines.

(3) The insertions of the glutei and the pyriformis are dissected off the great trochanter, leaving the periosteum and the obturator tendons *and associated vessels intact.*

(4) The great trochanter *with* the complete digital fossa is chiselled off the shaft and neck, and pushed out of the way for the time being.

(5) The block of bone A, B, E, D, C is removed. (See fig. 1.)

FIG. 1.—Lines of section of bone.

(6) The fibro-periosteal flaps are sutured, enclosing the raw infero-external surface of the head where the neck has been removed.

(7) The great trochanter is turned down, C to E, and sutured, or bone-pegged, in position, covering the whole raw upper end of the shaft. (See fig. 2.)[1]

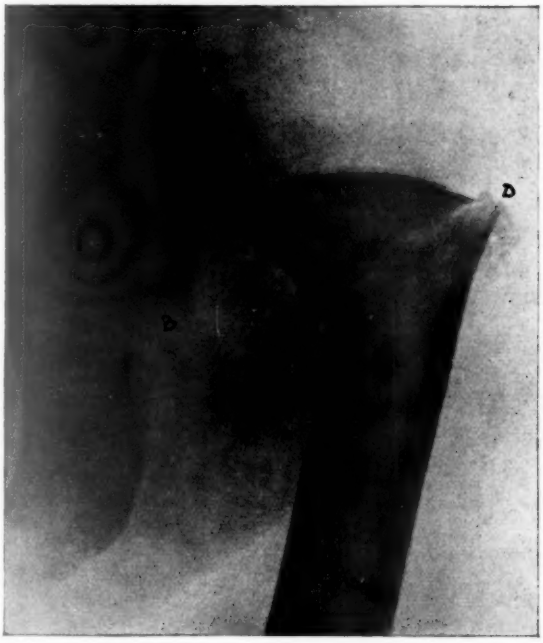

FIG. 2.—Great trochanter is turned down as if hinged at D.

[1] For the loan of the blocks illustrating this communication the speaker is indebted to the proprietors, Oxford Medical Publications.

Section of Orthopædics.

President—A. S. Blundell Bankart, M.Ch.

Congenital Synostosis of Humerus and Radius occurring in Three Children of One Family.

By Paul Bernard Roth, F.R.C.S.

There are five children in the family.

(1) N., a girl (the eldest), is normal.

(2) I., a girl, aged 8 years 9 months, was born with both elbows fixed at right angles. She was operated upon when 15 months old; the right elbow was excised, and put up at 125°, in that position it is now firmly ankylosed by bone. An attempt was made to get a movable joint in the left elbow, the radius being separated

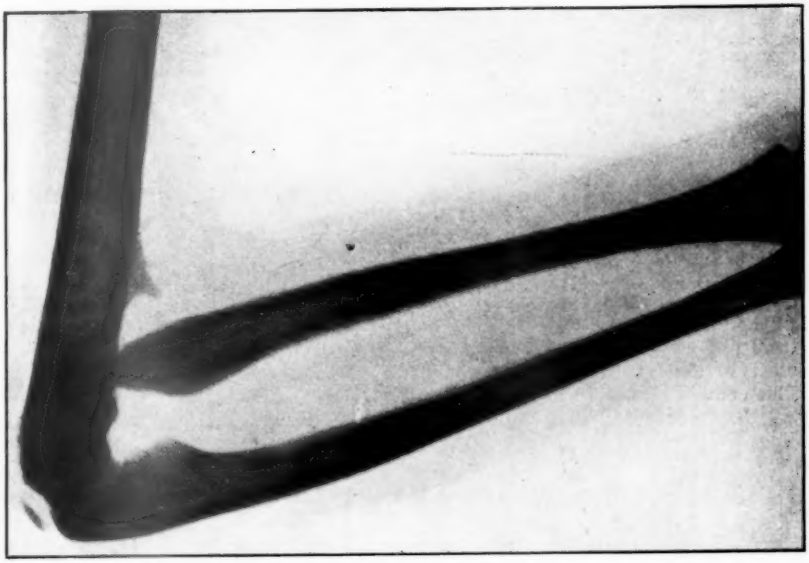

Fig. 1

from the humerus and inserted in a socket cut in the anterior surface of the lower end of the latter (see radiogram, fig. 1). So far this has not been successful, and the elbow is fixed at 80°.

(3) G., a boy, aged 7 years 9 months, was born with both elbows fixed at 80° (see radiogram of left elbow, fig. 2). The medullary cavity of the humerus and radius is continuous.

(4) L., a boy, is normal.

(5) J., a boy, aged 2 years 4 months, was born with both elbows fixed at 70°. The mother is pregnant with a sixth child.

Remarks.—The radiogram of G——'s left elbow can be taken as typical of his other elbow, and of J——'s two elbows; in all the medullary cavity of the two bones is continuous.

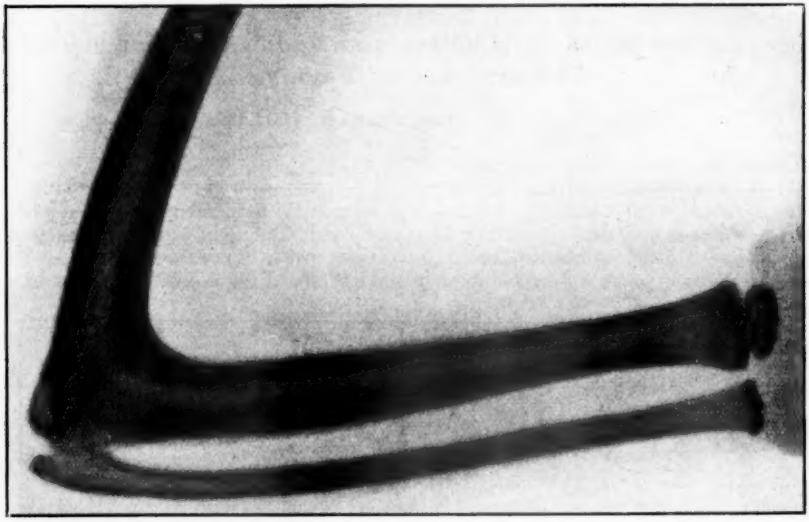

FIG. 2

Radiograms taken of the knees of the three affected children show that the upper end of the fibula is missing in each limb, and that there is apparently no patella.

It is proposed to operate on the *left* elbows of G—— and J——, so as to get ankylosis at 125°.

This condition appears to be a very unusual one.

Case of Congenital Dislocation of Both Hips, treated by Bifurcation Operation.

By R. C. ELMSLIE, O.B.E., M.S.

I. F., AGED 10 years six months, admitted to hospital in July, 1925, suffering from congenital dislocation of both hips, untreated. There was a bad rolling gait and great lordosis. An X-ray showed the heads of both femora placed very high above the acetabulum.

A weight extension was applied to both lower limbs for two months.

October 2, 1925.—Oblique osteotomy of both femora below the level of the great trochanter, the line of section being directed upwards and inwards. The osteotomy was carried out by the open method, the lower fragment angulated on the upper, and its point pushed upwards and inwards towards the pelvis. The limbs were fixed in a long double plaster spica in wide abduction.

October 16, 1925.—An X-ray having shown that the osteotomy on the left side had been performed too low down, the plaster was removed. The left hip was flexed more and the upper end of the lower fragment pushed more directly towards the acetabulum.

October 30, 1925.—New plaster case with less abduction.

December 30, 1925.—Plaster removed. Patient allowed up, and re-education commenced.

At the present time, May, 1926, the lordosis has very greatly diminished; the hips are stable, Trendelenburg's sign being negative; the child can walk well and can run. Flexion of the hips is free up to a right angle position, and there is moderate range of abduction. X-rays show that on the right side the osteotomy has been carried out accurately, and that the upper end of the lower fragment is in the region of the acetabulum. On the left side the osteotomy is too low, and the upper end of the lower fragment is partly taking a bearing against the rami of the pubis and ischium below the acetabulum. The functional result at the present time is very good.

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VOLUME THE NINETEENTH

SESSION 1925-26

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Section of Otology.

President—Mr. G. J. Jenkins, F.R.C.S.

The Otolith Reactions.

By A. R. Tweedie, F.R.C.S.

After a brief reference to the experimental work of Professor Magnus and Dr. de Kleijn, the theories of Professor Quix, and the clinical application and significance of the otolith reactions, Mr. Tweedie showed some cases which, in his opinion, were illustrative of these phenomena.

Case I.—A little girl aged 6, in whom a complete left labyrinthectomy had been performed by Mr. Sydney Scott some few months ago. There was no spontaneous nystagmus and no spontaneous error either in the vertical or the horizontal "pointing" test, with the head erect; nor could any nystagmus or error in "pointing" be induced with alteration of position of the head, except when the head was inclined to the left shoulder. There was then a constant deviation of some 3 in. outward of the left arm in testing the vertical "pointing." The exhibitor suggested that under these circumstances there was some vascular stimulation of the stump of the vestibular nerve.

Discussion.—Mr. Sydney Scott said that he (the speaker) had operated on this patient's left mastoid because of chronic middle-ear disease, and recurrent attacks of pain and pyrexia. A fistula of the external semicircular canal was found at the time of the operation, and the labyrinth did not react to strong caloric stimuli while under light general anæsthesia. The labyrinth was opened above and below the facial nerve, and its contents removed. There was no disturbance of coördination before or afterwards, a fact which shows that destruction of the membranous labyrinth by disease had occurred months, if not years, previously, though a history of giddiness was unobtainable. Mr. Tweedie's demonstration plainly showed that there was lateral deviation while the patient was "pointing," with the left hand, only when the head was laterally flexed with the defunct labyrinth downwards. No error was observable, with the head in any position, when the patient was pointing with the right hand.

Case II.—A young man in whom a partial left labyrinthectomy had been recently performed by Mr. Capps. A similar case to the preceding, and showing the same error in the vertical "pointing" under the same circumstances.

Mr. Sydney Scott said that this patient had had facial paralysis for more than seven years. An operation had been performed on his left ear before the war. He had chanced to come to St. Bartholomew's Hospital during the week when Mr. Tweedie was there, and he (the speaker) asked Mr. Tweedie whether he could prove that the labyrinth had been destroyed or not. The otolithic reactions were the same as those in the first case. The left labyrinth did not react to labyrinthine stimulation by caloric tests.

Case III.—Patient, a young woman. In this case a left labyrinthectomy had been performed by Mr. Watkyn Thomas twelve months ago. There was no spontaneous nystagmus nor spontaneous error in either the vertical or the horizontal "pointing" with the head erect, nor could such error be induced with any alteration of the position of the head, except that when the patient was lying in the dorsal position, or when sitting with the head retracted, a nystagmus to the left was induced. Mr. Tweedie suggested that this reaction was due to some disturbance of the utricle.

Case IV.—An infant with some form of intracranial lesion (kindly sent from the Hospital for Sick Children) was also shown in the hope of demonstrating the neck and otolith reactions. Unfortunately, its usual condition was querulous, but in its quiet semicomatose phases when lying on the back the arms were raised, and if the head were inclined to the right or the left, the right and left arm respectively became more extended. These reactions might be due to either the neck or otolith reflexes or both combined; the only way to differentiate

would be to fix the child, with the head and body bandaged, to some rigid support, and then test whether the reactions still persisted; this child, however, was insufficiently comatose for any such investigation. (See *Journ. Laryng. and Otol.*, 1923, p. 654.)

In apologizing for the absence of detailed notes of these cases, the exhibitor asked for indulgence as he had only rather hurriedly collected them on the previous day—the infant he had seen only for the first time that morning.

He appealed to Members of the Section to test their cases in some such way as he had endeavoured to demonstrate, and to bring forward their results, so that by means of a collective review they might be able to determine the true clinical value and significance of these reactions. He urged that examination of all such cases should proceed in the ordinary way with a preliminary investigation of the nose, pharynx, naso-pharynx, Eustachian tubes, the objective appearance of the tympanic membranes and the functional condition of the auditory nerves, so that, as far as was possible, we should be in possession of these data of each case before proceeding to examine the vestibular system.

With regard to this system, he (Mr. Tweedie) reminded the audience that, as it was divisible anatomically into semicircular canal and otolith portions, so we had probably to regard it, physiologically, as representing kinetic and static control respectively. In both these portions it was apparently possible to induce similar reactions, such as nystagmus and "by-pointing."

It was therefore important that we should first ascertain the condition of the better-known kinetic portion, by obtaining a record of the reactions to the rotation, caloric and galvanic tests. (If, indeed, the latter did really represent the effect on the semicircular canals, and not that on the otolith apparatus, as might possibly prove to be the case.)

With all these data before us it would then be possible to refer any nystagmus, or error in "pointing," induced by the positional tests, to the static effect on the otolithic apparatus. (One should also always bear in mind, in addition, the phenomena of the neck reflexes—easily demonstrated in a rabbit—as potential complications of any positional test, during which the normal relationship of the head to the trunk was disturbed.

He suggested that the reports on these cases should be grouped as follows:—

(1) Cases of unilateral acute otitis media; in which a record should be made of the reactions obtained, before and after operation or spontaneous recovery.

(2) Cases of unilateral labyrinthectomy; unilateral lesions after "fractured base," and also in this connexion cases of unilateral microtia in infants under 3 months of age, in which malformation presumably also included absence of development of the "inner" ear. (This had already been referred to by Mr. Cleminson last year.)

(3) Cases of adults complaining of dizziness, associated principally with arterio-sclerosis, altered blood-pressure and other general senile changes in men, and with the climacteric in women.

(4) Toxic cases due to excess of, e.g., alcohol and tobacco.

(5) "Decerebrate" cases, in a suitable condition of coma, such as sometimes occur in connexion with intracranial tumours, certain stages of meningitis, hydrocephalus and apoplexy; these should afford an opportunity during some phase of their development for testing the neck reflexes.

As a provisional routine he was adopting the following method of testing these reactions:—

> With the patient sitting in the chair, and the head erect, the presence or absence of nystagmus is first observed and then the vertical and horizontal "pointing" reaction noted. The patient's head is then laid to the right shoulder, and after some thirty seconds an examination is again made as regards the nystagmus, and then the vertical "pointing" again tested while the head is still in this position. The head is then laid on the left shoulder and a similar

examination repeated. Finally, the head is laid backwards and after thirty seconds (the time which must always be observed as the latent period for reaction in these tests) the effect on the eyes is again examined for nystagmus, and, with the head in this position, the effect on the horizontal "pointing" noted.

If then any nystagmus or error in "pointing" were induced, the patient could be tested again, lying on the couch in various positions, whilst the head and body were maintained in their normal relationship—and thus the potential factor of a neck reflex would be determined or eliminated. This method is offered as a provisional working routine in order to comply with the teachings of Professor Magnus and Dr. de Kleijn (based on their experimental work on animals) and with their suggestions for testing their reactions clinically.

Discussion.—Mr. G. J. JENKINS (President) said that we must be careful not to argue too much from experiments on lower animals. De Kleijn held that he had only had two cases of pure otolithic disturbance; such cases must be rare. Very likely the otolithic organs were affected sometimes when there was extensive disease of the labyrinth. The clinical phenomena due to affections of the otolithic organs were bound to be obscure when other parts of the labyrinth were affected. The "past-pointing" which Mr. Tweedie had demonstrated might possibly not be the compensatory "past-pointing" found in disturbances of the semicircular canals. Could it be due to a true muscle reflex? He (the speaker) had had eight cases in which nystagmus could be produced by altering the position of the head so as to bring the otoliths into play. In most of these cases there was some affection of the semicircular canals, and he had therefore hesitated about bringing them forward as cases of true otolithic disturbance. A lady, aged 35 years, when tossing up a child with her head held on one side, fell to the ground. She sat up and was comfortable immediately. On going to bed and lying on the right side, she experienced the same sensation, and this was repeated. He (Mr. Jenkins) had found nothing wrong with her labyrinth, except that she had slight giddiness at times, and there was slight loss of bone conduction on the right side. But he could always cause nystagmus when the head was put on the right side, and that case was the nearest to one of pure otolithic disturbance that he had ever encountered.

Mr. A. CHEATLE said it was obvious that much spade-work was yet required to be done in the subject. He suggested that Mr. Tweedie should have diagrammatic models of the otoliths made, to be fixed on the top of the head in the same way as the King's College Hospital labyrinth models are fixed, so that they could be used for teaching and clinical purposes. At Cambridge, Dr. de Kleijn had insisted that in testing for the otolith reaction the patient should be laid prone on the table, the head and body being moved as one.

Sir JAMES DUNDAS-GRANT said that it was a question well worthy of consideration as to whether the action of the otolith, when it pressed on the macula, was that of a damper or a stimulus. Too much attention should not be concentrated on the otoliths, lest cerebellar troubles be overlooked. He (Sir James) had formulated a scheme of mnemonics for teaching purposes in regard to the otoliths, maculæ and cristæ. [The speaker illustrated his scheme.] He said there was one point on which all observers were agreed: that the patient with supposed otolithic disturbance derived the greatest relief when lying on the affected side. One did not know whether the diseased side was hyperæsthetic or paralysed, but when the patient lay on the diseased side the sagitta was dropping away from the macula.

Mr. SYDNEY SCOTT said that the President and Mr. Tweedie had made it clear that there were two distinct sets of events referable: (1) to the semicircular canals; (2) to the otolithic mechanism. During the stage of hyperstimulation by the caloric test there were normal "past-pointing" errors, presumably originating in the semicircular canals. But the President had mentioned one case in which the "past-pointing" error was obtainable during static stimulation, when there was no disease of the semicircular canals, and he (the speaker) had also seen parallel cases in which the so-called otolithic reflex "past-pointing" error was obtainable in people with normal labyrinths. Recently he had seen a patient who had a plug of cerumen pressing on the drum, but nothing else abnormal, and his "past-pointing" reaction had disappeared when the plug of wax was removed from the drum. Why only some people showed such reactions when the conditions appeared to be alike, he did not know. "Past-pointing" was also obtained from the static stimulus as well as from caloric

stimulation when one Eustachian tube was obstructed in certain individuals. Presumably the stapes was then pressed inwards on one side only, compressing the labyrinthine fluid. Sudden relief of that extra pressure would cause the "past-pointing" forced movements in one direction; and if the pressure was suddenly reapplied the forced movements were reversed. Thus the same labyrinth would give "past-pointing" to one side or to the other, according to the raising or lowering of the pressure on one side in comparison with the pressure on the other side.

Mr. TWEEDIE (in reply) said that he had described the direction of the nystagmus by the direction of the quick movement—as he thought this was the plan universally adopted—but he agreed that the slow component was the real labyrinthine reaction. As to there being a "damping" action—he would remind Members that Magnus and de Kleijn had distinctly described these reactions in reference to their "maximal" and "minimal" positions—they considered that there was always a *constant* stimulus normally, which was modified by position, and in that sense he (the speaker) presumed one might speak of a position in which a "damping" action took place. He believed that these "otolith" phenomena were usually referable to some local lesion combined with a "general" pathological factor. He thanked Mr. Cheatle for his suggestion as to another diagrammatic model to fix to the patient's head, and he would try to adopt it. He quite agreed as to the importance of recognizing and eliminating the potential factor of neck reflexes. In reply to Sir James Dundas-Grant he said he thought that the side on which a patient preferred to lie after an operation on the labyrinth depended on whether the operated side was hyper- or hypo-sensitive.

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Recovery of Facial Nerve after Seven Years' Paralysis.

By W. IBBOTSON, F.R.C.S.Ed.

A. B., AGED 42. Chronic left tympanic suppuration. First seen in 1918. Then found to have complete left facial paralysis. Radical mastoid operation—no improvement in facial paralysis.

October, 1925.—For several months past the facial paralysis has been gradually diminishing and the function of the facial nerve is now almost completely restored. No further operation has been performed.

Discussion.—Mr. SOMERVILLE HASTINGS said that in 1913 he had performed labyrinthectomy on a patient, and three weeks later a complete facial paralysis had supervened. For three years the case had been treated by faradism; during that period of time reaction of degeneration was frequently reported. As the patient was uncomfortable, especially when eating, he (the speaker) had turned down a piece of the masseter. Following that, there was some improvement. After four more years, i.e., seven years after the original operation, the patient's state of health had begun to improve, and he (Mr. Hastings) had shown her to his students as a successful case in which the turning down of the masseter had helped the condition of the face. One observant student, however, had pointed out that it was not the masseter which was doing the work, but the facial muscles, which were then recovering! The face had since recovered completely.

Mr. G. J. JENKINS (President) said he had seen a case of facial paralysis recover after fourteen months.

Meatal Swelling for Diagnosis.

By CHARLES J. HEATH, F.R.C.S.

MISS T. Right aural discharge nine years. Conservative mastoid operation 1909. After that patient quite well with excellent hearing until spring, 1925, when a painless swelling occurred in the ear which ruptured spontaneously several times, and then healed up firmly and increased in size. On examination a blue swelling was seen pressing against the anterior wall of the bony meatus. It did not pulsate. When it was punctured mucus and blood escaped, and this discharge still continues. The drumhead appears intact and the hearing is good.

Mr. JENKINS (President) said that most members had occasionally seen conditions somewhat like this. He (the speaker) remembered one case in which, following a radical mastoid operation, a curtain had formed across the cavity, and the loculus was filled with blood-stained fluid.

Case showing Result of Conservative Mastoid Operation.

By CHARLES J. HEATH, F.R.C.S.

LIEUTENANT A. J. M. Left ear: radical mastoid operation 1908 after eight years' discharge from the ear. Right ear: conservative mastoid operation 1910 for otitis media of a few days' duration, as the perforation was rapidly enlarging and the left ear was defective in hearing power. Recurrence on right side due to a cold in 1923 on patient's return from Aden. Discharge through aditus, not through drumhead. In a week or two the Eustachian tube cleared and the aditus closed, the operation originally adopted having made observation and treatment easy. The patient depends on this ear in his work.

Case showing Result of Conservative Mastoid Operation on Both Sides.

By CHARLES J. HEATH, F.R.C.S.

MR. T. Acute double mastoiditis, following prolonged cold in head. Left ear first operated on, and at same time paracentesis on right. Mastoid operation on right; a few days later obstruction to antral drainage on each side. Hearing apparently not diminished by the illness.

Discussion.—Mr. JENKINS (President) asked Mr. Heath in what way this operation he did was more conservative than the Schwartze operation.

Mr. HEATH (in reply) said that the advantage of the operation he did over Schwartze's operation was, that if any recurrence took place it could be treated through the meatus, and discharge did not come through the scar. At the Downs Hospital at Sutton where he worked, the resident medical officer did not always refer recurrences (after Schwartze's operation) to him, but made an alteration in the operation by a fresh incision and taking away the posterior meatal wall. At that hospital no Schwartze operation was now done. Most of the chronic cases and all the fairly early ones were operated upon by the method shown in the case now exhibited (Case III) and it very rarely happened that any difficulties with the dressing were encountered. Although the patients were all children, the Sister told him recently that she had dressed 110 cases that morning. As soon as the post-aural incision was healed, the bandage was abandoned. He recently visited Queen Mary's Hospital at Carshalton to operate on two Ward-Sisters, and fourteen days later he went down again to see them. They were then at work in the wards, there was no perforation, and they had no wool in the ears. Their ears had been dressed by the same Sister who had done the 110 dressings in a morning. The same operation was performed in these chronic cases also; the Schwartze operation was not adopted there.

Section of Otology.

President—Mr. G. J. Jenkins, F.R.C.S.

The Pathological Conditions Found in a Case of Deaf-mutism.

By Albert A. Gray, M.D., and Sarah H. Nelson, M.D.

(ABSTRACT.)

The patient, aged 56, male, a deaf mute, died of malignant disease of the stomach. There was no case of deaf-mutism known among his ancestors. He was one of a family of six, of whom one brother was a deaf-mute. The patient had five children, but none of them were deaf-mutes. Hence there is no evidence of hereditary deaf-mutism, unless the occurrence of deaf-mutism in the patient's brother be considered such. The condition, however, may have been due to some pre-natal infection having damaged the organ of hearing in the two brothers.

Pathological Examination.—The middle ear was normal on both sides. In the *right* cochlea there was reduplication of the membrane of Reissner in the lowest whorl. In the middle whorl there was an over-development of the stria vascularis to a striking degree. In the apical whorl the membrane of Reissner was folded and refolded upon itself, and was incorporated in its outer portion with portions of the stria vascularis. In all three whorls the tectorial membrane was only partially developed and lay coiled up in the sulcus spiralis. The rods of Corti were well-developed in all three whorls, but there was no evidence of any hair cells or supporting cells. The nerve-cells in the ganglion spirale were normal in appearance, but were fewer in numbers than in a healthy ear. The conditions found in the left ear were very similar to those found in the right, but were not quite so marked in degree.

The most interesting feature of the case is the remarkable development of the stria vascularis and the membrane of Reissner. The appearance of these structures bears a considerable resemblance to the tegmentum vasculosum of the bird and reptile; and it is probable that there has been an attempt on the part of the embryonic cells to produce a structure which has previously been present in the reptilian stage of the evolution of the race.

Examination of the nerve structures revealed very little, if any, departure from the normal. As regards the auditory nerves these appeared to be normal in all their parts, cochlear and vestibular. The facial nerve, also, was normal in appearance. In the medulla and lower pons the cochlear and vestibular nerve-roots were healthy, and there was no apparent deficiency in the number of cells in either the lateral or ventral portions. The ganglion cells themselves were normal. The lateral fillet was normal on both sides, and the cells in the posterior quadrigeminate bodies were normal. There was no deficiency of the cells in the temporo-sphenoidal lobe, and examination of Broca's area revealed no abnormality.

Discussion.—Dr. J. S. Fraser said he did not quite agree with Dr. Gray's interpretation of the origin of this case, which might be a case of hereditary deafness, although the patient's parents were not deaf. In each parent there might have been what had been called "hybrid hearing" or "hybrid deafness." They would then, working the point out on Mendelian lines, if they had had eight children, have had two deaf children, two with pure hearing, and four with hybrid deafness. It was found that they had actually six children, two of them being deaf, and that approximated, on Mendelian lines, to what one would expect. As to the fact that the patient married a deaf-mute woman, and that they had only hearing children, it was quite possible that the wife was a case of acquired deaf-mutism due to labyrinthitis, and that

she was really a "pure-hearing" woman. In that case all the children would hear, but would carry deafness, i.e., they would be hybrids.

In seeking for a cause he (the speaker) did not think there was any need to drag in syphilis or fœtal meningitis as an explanation of the pathological lesions. He regarded these cases as on the same lines as cleft palate and other instances of abnormal development. When the mechanism of the production of cleft-palate was explained, probably these cases of congenital deafness would also be cleared up.

With regard to the abnormal formations in the scala media, originally the cochlear canal was circular or oval, and was lined by an almost uniform layer of cubical epithelium. This became specialized or differentiated at two particular places: (1) Where the organ of Corti was formed; (2) where the stria vascularis was developed. As Dr. Gray had said, in these cases of congenital deaf-mutism there was a tendency for over-development of the stria vascularis and for under-development of the organ of Corti. In most of the congenitally deaf white bull terriers examined by the speaker there had been hypertrophy of the stria vascularis, at any rate in parts, along with marked under-development of the organ of Corti. An interesting feature about the histological examination of the ears of deaf-mutes was that the membrana tectoria was almost always in an abnormal position; he scarcely knew of a case of deaf-mutism in which the membrana tectoria was normal. He (Dr. Fraser) did not go as far as Shambaugh, of Chicago, in the view as to the importance to be attributed to this membrane. Still, unless the hair-cells of the organ of Corti had something "to come up against," they could not be stimulated. If the tectorial membrane were tucked into the internal spiral sulcus, or on the top of Huschki's tooth, then, even if the rest of the organ of Corti were well developed, there would be no sensation of sound.

With regard to the question of hair-cells, he did not know what Dr. Gray's experience was, but he (the speaker) could not demonstrate the hair-cells by the methods he had used in human labyrinths obtained twenty-four to forty-eight hours after death. It was different if one experimented on cats, dogs, and guinea-pigs, for in them one could demonstrate the hair-cells when the temporal bone was fixed at the moment of death. As, however, they could be demonstrated in man only in exceptional cases, he did not think much stress could be laid on their apparent absence.

Dr. Gray had pointed out the dilatation of the scala media. In the case of developmental deafness he (Dr. Fraser) had shown to members of the Section some years ago that the scala media on one side was enormously dilated, so that Reissner's membrane was bulged upwards, and there was scarcely any scala vestibuli left, whereas, in the other ear of the patient, the scala vestibuli was collapsed and Reissner's membrane had sunk down on to the remains of Corti's organ.

What Dr. Gray said about reptiles and birds had specially interested him (the speaker); this showed that when there was any difficulty about the interpretation of abnormalities one should turn for help to the subjects of development and comparative anatomy. He (Dr. Fraser) agreed with what Dr. Gray had said about the comparative anatomy of these structures.

With regard to Dr. Nelson's examination of the nerve tracts and centres, he (the speaker) thought there had been far too few cases in which the nervous system had been examined. The brain of the case of congenital or developmental deafness, which he had reported on, had been lying in fixing solution for years, and as yet he had not been able to get any neuro-pathologist to examine it.

Mr. J. F. O'MALLEY asked whether Dr. Gray considered that the condition which he had found meant that there had been a reversion from the normal, or that, as Dr. Fraser suggested, there had been an arrest of development. His own view was that the latter would explain the condition in a satisfactory way, because in various regions of the human body, in the fœtal stage, there were appearances which bore strong resemblances to those found in the lower animals. That seemed more likely than that it was an atavism.

Mr. F. W. WATKYN-THOMAS asked whether Dr. Nelson could say what degree of decussation took place in the cochlear fibres. He (the speaker) had examined patients whose temporo-sphenoidal lobes had been injured, and he had been struck by the rarity of deafness on the opposite side. If there had been complete or hemi-decussation, one would have expected a good deal of contralateral deafness, as in several cases there had been injury to the transverse gyri of Heschl.

Mr. G. J. JENKINS (President) said that in his opinion Dr. Gray had satisfactorily explained the microscopic appearances of the cochlea in cases of deaf-mutism. He thought the changes might be regarded as a true atavism. He asked whether a similar appearance in the cochlea of the mammalian embryo had been found, as probably at some brief period this stage did exist.

Dr. GRAY (in reply) said that this case might be one of true inheritance, but he (the speaker) thought the evidence in favour of that possibility was very slight. There were two deaf-mute individuals who came in the one family, and none of their children were deaf, none of the aunts and uncles and neither parent were deaf. The patient's wife was deaf-mute. (Dr. FRASER: The patient's wife might have been a case of acquired deaf-mutism.) But it might also have been a biological case, therefore that suggestion did not carry one much further. At any rate, none of the children were deaf. In the case of the deaf dog about which Dr. Fraser spoke some time ago, it would be interesting to know whether the development of the stria vascularis resembled that of this deaf-mute. In Dr. Fraser's dogs the deafness came on in generation after generation, as deaf-mutism sometimes did through true inheritance, but there was no evidence of that here.

Dr. Fraser had said that the hair-cells could not be demonstrated in the human subject, and he (the speaker) agreed with him that such was the case if the sections were cut by the ordinary celloidin process; but if one cut thin sections by special methods, as had been done in otosclerosis, the hair-cells came faintly into view, and the hairs showed up well.

The President and Mr. O'Malley suggested that the appearances described might be examples of arrest of development, and he (the speaker) had considered that possibility in this case. Investigations of the embryology of mammalia, however, failed to show the presence of a tegmentum vasculosum during embryonic life. It might be, however, that, as the President suggested, the stage at which there might be a tegmentum vasculosum was so short that it had not yet been observed. If such a stage could be found in the mammalian labyrinth he (Dr. Gray) would agree that this was an arrest of development. Until such a stage were found he would say it was the result of repair following toxic or other injury.

Dr. SARAH NELSON (in reply) said that evidently there was decussation of the cochlear fibres, because if one removed the cochlea in young animals there was found to be atrophy of the opposite posterior corpora quadrigemina. The cortical area, however, was very small, and if there were destruction of the whole, one would expect some reduction in the patient's hearing capacity.

[*February* 6, 1926.

DISCUSSION ON FRACTURE OF THE BASE OF THE SKULL; AND THE EAR, NOSE AND THROAT SURGEON.

Mr. G. J. JENKINS (President).

IN opening this discussion I propose to deal with certain general principles of surgery, rather than with symptoms and signs or permanent effects of injury to parts in which this Section is particularly interested.

Although it may be generally recognized that examination of the ear and nose is advisable in cases of suspected fracture of the base of the skull, yet in many hospitals the oto-rhinologists are not asked to make this investigation. This is a mistake; for, unless a skilled and thorough examination is made of the ear, nose and throat, some cases of fracture of the base are likely to be diagnosed as simple brain concussion. Usually this is not likely to lead to serious consequences, as the treatment of the two conditions is more or less the same. Occasionally results are not so satisfactory as would be the case if the lesion had been recognized.

Again, oto-rhinologists have taken rather a narrow view of fracture of the base, and have been content with a description of damage in the region of the ear and nose, and symptoms and signs peculiar to the lesion. Ought we not to consider how we can best apply our special knowledge to the diagnosis, general management and treatment of fracture of the base?

I do not propose to discuss the mechanics of fracture of the base, or the various symptoms and signs of this injury, but rather to deal with less obvious clinical signs of fracture, and problems in management particular to our special region.

In all cases before making a routine examination of the nose and ear, it is important to know whether there has been a chronic sepsis in these regions.

Diagnosis.

The nose and ears should be carefully examined in all cases of serious head injury, even when no obvious sign of injury exists.

In hospital records you will commonly find a full description of the neurological and other symptoms, but the only reference, if any, to the nose and ears may be the simple note, "Bleeding from the ear," or "No bleeding from the ear or nose."

Bleeding from the nose in serious head injuries is commonly due to fracture of the base of the skull, but it may be due to an intrinsic injury of the nose. A short time ago a man had a fall, was unconscious for a time, and had bleeding from the nose. Fracture of the base was diagnosed, but there was a rupture of the mucous membrane on the right side of the septum, sufficient to account for the bleeding. The exclusion of a fracture of the base in cases in which there is an intrinsic injury of the nose must be very difficult if not practically impossible, and it is on this point especially that a discussion may be helpful.

Is loss of the sense of smell constant in fractures involving the cribriform plate?

On examination of the naso-pharynx a posterior hæmorrhage may be discovered coming from the roof, and occasionally a fine stream may be seen coming from the orifice of the Eustachian tube, even though no blood has been detected by examination with the tongue depressor.

Examination, however, is not complete until the nose has been examined for evidence of gross sepsis, and to this I would draw your attention particularly, as it may be a point for discussion later.

Fracture involving the Ear.

When there is either destruction of the labyrinth or a lesion of the lower neuron of the seventh cranial nerve, or severe bleeding, or a flow of cerebro-spinal fluid from a torn tympanic membrane, or from a wound of the meatal wall, then there is little doubt that fracture of the base has occurred.

We are all familiar with the symptoms and signs of destruction of the labyrinth, and these may be left out of the present discussion. One question arises, in case of injury of the labyrinth, and that is the possibility of a severe blow affecting the labyrinth without fracturing the capsule. Such a lesion has been demonstrated in lower animals, and it may possibly occur in man, though I myself have not met with it.

Injury of the seventh cranial nerve is common, and it is not unusual for the paresis to increase for two or three days after the accident.

When the patient is seen immediately after injury, there is considerable difficulty in examining the meatus on account of the free flow of blood. In my experience, which is not very large in this connexion, I have not been able to detect cerebro-spinal fluid in this free flow of blood. I have seen it when the flow of blood has entirely or almost entirely ceased. Even after the cessation of bleeding, there is sometimes difficulty in making out details of the injury, on account of the presence of blood-clot.

Practically there is no difficulty in making a diagnosis in cases of gross injury of the ear, and for the purpose of this discussion I would rather draw your attention to the less obvious indications of fracture involving this region.

The following is an example: A man was thrown from his bicycle. He was momentarily unconscious, but was able to get home without assistance. He saw a medical friend who recognized that he was ill, but could not find anything definitely

wrong beyond a slight deafness. On further examination, however, he was found to have middle-ear deafness on the right side. The right tympanic membrane was blue-black, and there was blood trickling in a very fine stream from the orifice of the right Eustachian tube. This is a typical example of four or five cases that have come under my observation and represent a class of fracture of the base which is apt to be missed if only a casual examination is made. In my opinion, the presence of blood in the middle ear is sufficient evidence from which to make a diagnosis of fracture.

Again, there may be fracture involving the bony external auditory meatus without rupture of the tympanic membrane or of the membranous meatus. In such the line of fracture may be indicated by a swelling, sometimes discoloured. At times the bleeding is very slight and the break on the wall impossible to find, but usually the swelling and distortion will indicate a bony injury.

For the purpose of comparison, examination of the other ear should not be neglected, and, of course, the presence or absence of chronic middle-ear suppuration should be noted.

General Management and Treatment.

Under this heading I would direct your attention to the important matter of the prevention of infection, especially preventing the extension of sepsis to the meninges.

When a healthy nasal cavity is involved, the obvious suggestion is to leave it carefully alone, but where there is severe damage to the nose, there is a temptation immediately to correct the deformity. Is there any risk in doing this when fracture of the base has not been quite excluded? What do you suggest should be done when there is gross sepsis in the nasal cavity?

Fracture Involving the Ear.

When there is no bleeding, I often advise dropping $2\frac{1}{2}$ per cent. alcoholic solution of iodine into the meatus, cleaning up the pinna and dressing aseptically. Frequently the bleeding is so profuse that the application of antiseptics is out of the question, and we have to be content for the time being with cleaning the pinna.

When the bleeding has subsided, or is only slight, the problem of cleaning the meatus arises. I know that many surgeons hold that any attempt to clean the meatus is associated with a greater chance of contamination than of sterilization. I do not agree with this, but at the same time I fully realize that care is necessary in removing the clot, and, possibly, also cerumen, in order to let the solution of iodine into the deeper part of the meatus. I do not advise the removal of thin, dry blood in the deep meatus, but prefer simply to fill the meatus with the iodine solution. Syringing the ear in these conditions is a practice that I regard with some apprehension.

What is to be done when a fracture has occurred through an ear with chronic suppurative middle-ear disease?

I know of two cases of fracture of the base, affecting an ear in a state of chronic suppuration, in which the patients recovered without any unusual symptoms, but I do not know that in either of these cases there was any escape of cerebro-spinal fluid. One would naturally suppose that the risk of extension of sepsis in such cases would be considerable, and that when the dura had been ruptured, as indicated by the escape of the cerebro-spinal fluid, the danger would undoubtedly be great. Since this question has arisen in my mind, the problem has not actually occurred in my practice. If there was an obvious escape of cerebro-spinal fluid in such a case, I should endeavour to make the drainage of the region as free as possible, even to the extent of going through some of the stages of a radical mastoid operation, and of exposing the dura along the line of fracture in the immediate neighbourhood. Should there not, however, be any indication that the dura has been damaged, I should clean up

the region as well as possible at regular intervals, and wait for other indications to proceed further. It is probable that in some of these cases I should operate as if damage had been done to the dura. My reason for not operating readily when there is no obvious evidence of a damaged dura, is that any operative procedure on the bone, in a case of recent fracture, may cause movements of the fragments and so cause serious damage to the dura. I do not think the risk of damage by the bone fragments is likely to be so great after two or three days have elapsed.

Lastly, I shall refer to certain cases of localized extension of sepsis that may come under our care.

Perhaps I can best illustrate what I mean by describing briefly two out of three cases that have come under my observation recently. A man about 30 years of age had a fracture of the base involving the external auditory meatus in the postero-superior part. About six or seven days after the accident he complained of pain in his right ear; there was marked tenderness over the mastoid process and there was facial paresis on the same side; there was also increase of temperature. I operated and found pus in the antrum and along the fracture. He recovered completely.

The second case was similar, but the pain and tenderness were localized over the squamous part of the temporal bone and there was definite œdema. On operation I found pus in the mastoid antrum and along the fracture, which involved the squamous part of the bone. It was necessary to remove most of the squamous portion, even as far forward as the temporo-sphenoidal suture.

It is possible that some of these localized extradural or even intradural abscesses may not be recognized until too late, unless the possibility of their occurrence at almost any stage of convalescence is kept in mind, and unless the patient is under constant skilled observation.

Sir Charles Ballance

said that hæmorrhage from the ear came from the tympanum, or from the veins sinuses, or surrounding arteries. He (the speaker) had never seen hæmorrhage from the internal carotid coming out of the external auditory meatus, except in a case of tuberculous disease of the petrous bone; though one was familiar with those cases in which fracture of the base and middle fossa passed through the anterior clinoid process and produced a pulsating exophthalmos due to an injury to the internal carotid artery and cavernous sinus. It was very rare for hæmorrhage to come from the lateral sinus. When it did occur it was likely to prove rapidly fatal. Hæmorrhage from the middle meningeal artery might also be very profuse. The surgeon must try to arrest the hæmorrhage: that was an ordinary surgical duty. Also, sepsis must be prevented, and if important parts had been interfered with, efforts must be made to restore function.

Hæmorrhage in some cases persisted for days, in others it was slight, and generally by the second day was no longer of importance. Associated with the hæmorrhage there was often concussion and unconsciousness, and then there was only one thing to do, namely, decompression, and the earlier this was done the better for the patient. One took away the thin bone in the temporal region, and came upon blood outside the dura. A bulging dark dura showed a collection of blood inside the dura, and it should be opened to let out the fluid blood and clot, then the wound should be closed. If there was hæmorrhage from the opposite ear, he (Sir Charles) advised repeating the operation on this side also. These operations should be done quite quickly; very likely by the next day the patient would have become conscious. This advice applied not only to the otologist, but to any surgeon. Harvey Cushing published sixteen cases before the war, and all patients except two recovered. All the sixteen were immediately trephined in the temporal region. When bleeding was profuse it showed the case was serious, also when the patient was only semiconscious or was unconscious.

With regard to nasal injury, the same principles should govern the treatment. He (the speaker) considered that the nose could not be rendered aseptic. When there was a fracture across the cribriform plate one should do a decompression and introduce some such material as sterilized gauze between the brain and the fracture, in order, if possible, to prevent infection. In some of these cases the fracture passed through the posterior fossa, and this was a much more serious injury, as the injury was nearer to the vital centres in the brain-stem; hence the operation should not be delayed.

The President had alluded to cases in which there was previous sepsis. If there was chronic mastoid disease, chronic temporal bone disease, and a fracture through the base of the middle fossa with blood coming from the ear, the surgeon's duty was to do a complete mastoid operation at once, to remove the septic disease and expose the dura, and if possible separate the dura from the fracture area, which was probably infected.

With regard to prognosis, it was difficult to know which patients would have meningitis and which would not. In cases in which the fracture was a bad one and blood poured down the pharynx it seemed as if there were no means of antagonizing sepsis, and that meningitis must result; yet in some such cases the patients recovered. Why meningitis developed in one case and not in another, he (the speaker) could not say, but he advised treating every case as if meningitis was likely to result, and so doing one's utmost to counteract the possibility.

Concerning the question of function, his own experience was that in some of these cases in which fracture occurred through the middle fossa, there was total deafness with total facial palsy. There might be recovery from the deafness, there was seldom recovery from total facial palsy. He (Sir Charles) thought the reason was that the internal ear was surrounded by very hard bone, and escaped fracture on that account, though it did not escape concussion and hæmorrhage; while the facial nerve in the aqueduct might be ruptured, and some displacement of the fractured ends of the aqueduct would take place so that union of the broken nerve became difficult. Moreover, so that a nerve which was in a bony canal could unite, much new tissue had to be formed; and the resulting pressure became a factor which also militated against the recovery of the facial nerve.

The main object of the surgeon, in regard to these fractures when seen early, should be to antagonize the unconsciousness of the patient and prevent the occurrence of sepsis by doing a decompression operation, and by causing a compound fracture to become by surgical means a simple fracture so far as the brain and membranes were concerned.

Mr. Sydney Scott

said that their experiences at St. Bartholomew's and King's College Hospitals were evidently very similar. A large number of skull fractures involved the middle ear only, especially in patients not fatally injured, and resulted in middle-ear deafness. There was a group in which absolute deafness occurred with destruction of labyrinthine functions, and in which there was facial palsy. The pathological specimens collected by Mr. Cheatle would include more seriously injured cases in contrast with others seen clinically. Cases of head injury, even with aural symptoms, were dealt with in other departments of the hospitals and the otologist was asked to see only certain ones occasionally. In the majority of those referred to the Ear Department, he (Mr. Scott) had found that the deafness was of the middle-ear type. The ultimate results were sometimes surprisingly better than one would expect. A boy to whom he had referred at a former meeting fell 40 feet on to a cement basement, and was brought in unconscious with bleeding and fragments of brain tissue in the ear (proved to be such by the microscope). A year later this boy had completely recovered. The drum membrane and meatus were normal and hearing was fully restored, sixteen double vibrations per second (Bezold-Edelmann series) being heard.

In a number of cases bleeding into the middle ear occurred without ruptured tympanic membrane, and when it was possible to keep the Eustachian tube clear, there had been much improvement in hearing. Of course many cases were hopeless.

Grave injuries were sometimes of academic interest only. He (Mr. Scott) had secured the temporal bones of a deaf-mute child who had been killed by a motor omnibus, a wheel having passed over the child's head. The petrous portions of the temporal bone had been dislocated *en masse* into the brain tissue on each side. He (the speaker) had found evidence of advanced middle-ear disease of long standing and this would explain the deaf-mutism.

As to treatment; when there was rupture of the meatus or membrane, he would avoid syringing or irrigation; he preferred to remove the débris with forceps and to employ drying methods. His own experience in cases in which there was already chronic suppuration and fracture of the temporal bone had been unfortunate; the greater proportion of the patients had died from meningitis, scarcely any from brain abscess. Lateral sinus infection in these cases was unusual. In cases of fractured temporal bone, with chronic middle-ear suppuration, he advocated mastoid drainage.

Mr. A. R. Tweedie (Nottingham)

said he hoped this discussion would lead to the compilation of some statistics with special reference to fractures involving the petrous bone and nasal cavities. He agreed with the President as to the importance of otologists seeing these cases as soon as possible, both as regarded immediate therapy, by way of assisting towards the maintenance of function, and also with a view to possible questions of compensation in the future. He (the speaker) also advised the avoidance of operative interference except in cases in which a suppurative otitis media was already present.

With regard to the nose, we should largely rely on the physiological action of the nasal mucus, and if any assistance were required this should be restricted to the use of ointment or liquid paraffin.

Mr. J. F. O'Malley

said that hitherto the otologist had proceeded in this kind of case in a somewhat haphazard fashion; but if the statistics asked for by Mr. Tweedie could be collected, they would put otologists on the look-out for such cases.

He (the speaker) had had a case of fracture of the base associated with loss of smell in an Air-officer who had had a crash. There had been hæmorrhage from the anterior fossa, and subsequently the loss of smell had occurred.

With regard to treatment from the aural surgeon's point of view, he (Mr. O'Malley) considered that as little as possible should be done, and he would be very careful even about syringing. There seemed to have been a consensus of opinion during the War that in cases of injury of membrane from gun-fire it was unwise to syringe, and it was probably equally unwise to do so in these fracture cases. Some escape of blood was beneficial from its immunizing effect on any sepsis in the wound. A good method of keeping the wound free from sepsis was to pack with boracic powder; this caused free exudation of serum from the blood-supply in the neighbourhood of and through the wound.

Mr. Arthur H. Cheatle

showed twenty-three specimens, from the Royal College of Surgeons' Museum, of fracture of the base of the skull involving the temporal bone, seventeen from his own collection and six from the main part of the Museum. The most common type, seen in ten specimens, showed a double line of fracture, one line passing through the roof of the middle ear and meatus and the other through the roof of the middle ear, antrum and posterior meatal wall separating a somewhat triangular piece of the squamo-zygomatic portion.

Mr. Cheatle said that some years ago he had shown at a meeting of the Section a patient who, many years previously, had suffered such a fracture and in whom the healed line of fracture could easily be seen in the posterior meatal wall; the membrane was intact and the hearing good.

In only four specimens had the fracture passed through the bony labyrinth, so that the deafness following a fracture of the base was more often of the middle-ear variety, although internal ear deafness might be associated, due to concussion or hæmorrhage, in those cases in which the fracture did not pass through the labyrinth.

It was obvious that a fracture involving the temporal bone might occur without the escape of cerebro-spinal fluid, which was due to tearing of the meninges, fracture through the labyrinth or both. It might also occur without hæmorrhage from the ear; some years ago he (Mr. Cheatle) had examined a boy who had been thrown from a moving motor-car on to his head; he was deeply unconscious, the left middle ear was seen to be full of blood with an intact membrane and no sign of injury of the meatal wall, and blood could be seen trickling down the pharynx from the naso-pharynx, but none from the front of the nose. The meatus was purified and an antiseptic dressing applied in case rupture of the membrane should occur; this did not happen, the blood became absorbed and the hearing was ultimately unaffected.

The facial nerve was divided in eight of the specimens shown and the Fallopian canal was opened in two; there was therefore a hope of recovery in cases of paralysis in fracture of the base. In all fractures of the base of the skull an examination should certainly be made of the ears. If there was injury, purification of the ear should be carefully undertaken; he wondered whether this had been done in the cases related by the President, in which sepsis had occurred some time after the injury.

The purification of the ear should be carried out on a definite plan. If a platinum loop smear was taken from the cartilaginous meatus among the hairs and cerumen, a plentiful growth of all sorts of organisms could be obtained, while, if it was made in the deep meatus through a purified speculum, little, if any, growth resulted, so that if the ear was purified by initial syringing, organisms were likely to be driven right down to the site of injury in the deep parts. It was wiser first to scrub the concha and cartilaginous meatus with a strong antiseptic, using mops of wool or gauze, and then fill to the meatus through a purified speculum with the warmed solution, letting it stay there for a quarter of an hour, and then, after purifying the outer parts, applying the outer dressing. The antiseptic he (the speaker) used was 1 to 20 carbolic, which had the power, as Lister used to point out, of penetrating greasy substances, a power which perchloride of mercury did not possess.

It was a difficult question to decide as to what should be done if a fracture passed through an ear in which there was chronic middle-ear suppuration. The President had knowledge of such cases in which nothing operative had been done and nothing untoward had occurred. He (Mr. Cheatle) had not met with such a case, but in the light of the President's cases he should feel inclined to adopt an expectant attitude, especially if there were no flow of cerebro-spinal fluid, for in operating there might be a risk of opening up fresh areas for infection.

Mr. G. J. Jenkins (President)

(in reply) said that he still had some doubt as to whether one should operate in all cases in which there was suppuration of the middle ear. The difficulty was that one did not know when the dura had been damaged.

He agreed with Mr. Cheatle that the meatus should be cleaned up. There had not been much said in the discussion as to the methods of doing this. He did not use carbolic, but iodine solution.

Report on a Case of Otogenic Encephalitis. Treatment by Decompression. Recovery.

By DAN MCKENZIE, M.D.

THE patient, a lady, aged 59, had a radical mastoid operation performed in Montreal by Dr. R. H. Craig in April, 1923, for chronic suppuration of the middle ear. The middle fossa was low-lying and "the dura was exposed for half an inch square in front of the sinus." Convalescence "was protracted." "At no time was there any evidence of labyrinthine or intracranial involvement apart from occasional attacks of dizziness on rising in the morning." She remained under Dr. Craig's care until October, 1923.

In 1924 she came under the care of Professor Ruttin, of Vienna, who found the external meatus contracted.

In February, 1925, when I first saw her, I found the meatal lumen reduced to about the diameter of a pin-head, and as deep pulsation was visible and there was considerable purulent discharge, a re-opening of the mastoid was made. At the operation I was surprised to find that the pulsation was cerebral and that in a mass of granulations in the upper part of the mastoid cavity there lay the opening of a sinus leading about $1\frac{1}{2}$ in. into the temporo-sphenoidal lobe. The tympanic cavity was filled with dense fibrous tissue, so that the source of the free discharge from the ear must have been the sinus in the brain. When and how this sinus formed nothing in the history was forthcoming to tell us. At no time had there been any phenomena suggestive of brain abscess.

Ten days after the re-opening the patient was seized with general epileptiform convulsions lasting five hours; and two days later she was seen by Sir Charles Ballance who advised free exposure and incision of the dura of the fossa. The base of the antro-tympanic and mastoid roofs being removed, along with part of the squama, the dura was opened from end to end of the exposed area. The brain immediately herniated in a mass into the mastoid operation cavity. The post-aural wound was closed, and since then (March 7, 1925) no further serious symptoms have appeared. The ear still discharges some pus, but the patient is leading a normal life (December 10, 1925) and has returned to her home in Canada.

Discussion.—Mr. G. J. JENKINS (President) said that the notes suggested the possibility that at some time there had been an injury of the brain or dura in that region.

Mr. SYDNEY SCOTT said that he had seen a very slight abrasion without a penetrating injury of the dura mater followed by infection which had passed through the dura. This, as the late Mr. Hunter Tod had pointed out, also led to infections of the lateral sinus.

Mr. LIONEL COLLEDGE said that the history given of this case suggested that a complication had arisen from want of drainage through the meatus, although a radical mastoid operation had been performed. He (the speaker) assumed that no flap had been cut, or, if so, that part of the operation had failed. He knew of a case in which a woman had undergone an operation for lateral sinus thrombosis, and, although desperately ill, she had recovered. Fifteen years later she was sent back to the hospital very ill; pus cells were present in the cerebrospinal fluid. He (Mr. Colledge) had re-opened the back of the ear and found that behind the cartilaginous meatus pus had collected and had ulcerated through the dura. There was an abscess of the temporal lobe. He (the speaker) had cut a wide flap, and, after repeated lumbar punctures the patient had recovered. He thought the making of an adequate opening through the meatus was very important in doing a radical operation.

Mr. T. H. JUST said that he had had a case which was similar to that shown by Dr. Dan Mackenzie, as his (Mr. Just's) patient also had suffered from generalized convulsions. There might be infection of, and within, the dura without any very obvious cause. He (the speaker) had had a patient, a child, aged 7, on whom he had performed a radical mastoid operation. The case had been apparently straightforward. The dura mater was not exposed during the operation. Three days later there was a generalized convulsion, which lasted for two hours.

He (the speaker) had made a lumbar puncture and found that the fluid was under slightly increased pressure, but was not turbid. He had removed the tegmen antri and opened up bone over the middle fossa. He had found a localized area of the dura mater about the size of the end of a lead pencil, which was dusky blue in colour, and was obviously infected and almost gangrenous. He presumed that there had been some infection of the bone in contact with the dura mater at this point. He had excised the infected dura mater and made two parallel incisions through the dura both above and below the infected area. Cerebro-spinal fluid under tension flowed from the incision. The brain had herniated into the openings. He (Mr. Just) thought that the fit was due to cortical irritation, brought on by the localized serous meningitis. The child had made a good recovery. The infection of the dura mater would probably have gone on to a severe intracranial lesion, either meningitis or brain abscess, if free drainage had not been provided at the time.

Dr. DAN MCKENZIE (in reply) said he agreed that injury to the dura was a possibility in the case. It was certainly remarkable that the dura was so frequently exposed in operating, yet so little harm resulted. And it must be often punctured in operations without any serious result. He thought an abscess must have followed the first operation and burst spontaneously into the mastoid cavity.

Report on a Case of Necrosis of the Petrous Bone with Unusual Complications.

By F. W. WATKYN-THOMAS, F.R.C.S.

MRS. S., aged 54, came to hospital on January 1, complaining of headache for three days and pain in the right ear. The meatus was blocked by a polypus; there was no pain or vertigo produced on moving the polypus. It was snared under gas anæsthesia, and she went home quite well an hour later. The same night she had violent vertigo, with falling to the right. She was admitted to hospital on January 2. When sitting she fell to the right, but the nystagmus was to the right and bone conduction was present. Cold caloric test on the right gave normal nystagmus with normal reversal on forward bending. On this evidence it was decided that the right labyrinth was active. A radical mastoid operation was done. The mastoid was eburnated and acellular; cholesteatomatous débris was found in the antrum; there was a fistula above the ampulla of the external canal. The stump of the polypus was found in the sinus tympanicus. Lumbar puncture yielded clear cerebro-spinal fluid not under increased pressure. On the morning of January 3 she was much better, but the night temperature rose to 101° F., and the following morning the nystagmus had swung over to the left; there was right-sided facial paralysis, ptosis and ophthalmoplegia of the right eye, and she was very drowsy. Lumbar puncture showed turbid fluid under pressure. The mastoid cavity was re-opened, and the labyrinth opened above and below the facial nerve. Pus was found in the labyrinth and was followed upwards and inwards through the petrous bone, forward into the middle fossa, apparently in the region of the cavernous sinus. A translabyrinthine drainage was then done, but no flow of fluid was obtained (it was discovered, post mortem, that the internal auditory meatus was blocked with blood-clot). Accordingly the dura was exposed behind the descending portion of the lateral sinus and incised; a rubber tissue drain was passed forwards in front of the cerebellum. The patient never recovered consciousness and died that night. Autopsy (by Dr. Scott-Williamson) showed necrosis of the whole petrous, extending to the apex; the Gasserian ganglion was disintegrated and lay in a pool of pus, there was thrombosis of the cavernous sinus and of the internal carotid within the sinus. There was extensive sub-pial hæmorrhage over the pons and mid-brain. There was no sign of infection of the sphenoidal air sinuses, and the opposite temporal bone was absolutely normal and of a highly cellular structure.

Discussion.—Dr. SCOTT-WILLIAMSON said that he had made the post-mortem examination on this case, and had found septic necrosis of the petrous bone. In taking out the left petrous bone he had noticed that the sepsis and necrosis had spread to the extent of involving the roof of the bony canal of the carotid, and had induced an ulcer on the artery. And it was curious that the sepsis had spread between the dura and the bone, forward towards the Gasserian ganglion, rather than over the roof of the ear itself. There was a very mild degree of meningitis, namely, in scattered petechiæ over the meninges. The cerebro-spinal fluid and the bone had yielded pure growths of staphylococci. In 230 post-mortem examinations in these ear cases apart from tuberculosis, he (the speaker) had encountered necrosis of the petrous with staphylococcus in eleven cases, in two cases the pneumococcus was also present. That almost suggested that this necrosis was primarily a staphylococcic infection of bone.

Mr. G. J. JENKINS (President) said that for such an extensive lesion to have formed, the process must have been very rapid, and there must have been a very extensive system of air-cells to the tip of the temporal bone. Mr. Cheatle's specimens of temporal bones included such a type. He asked whether in this case the extension of pus was beneath the semicircular canal, or over the canal. It was fairly easy to explain extension of middle-ear sepsis to the posterior aspect of the temporal bone, but it was not so obvious how it might get to the superior aspect.

Fistula of Semicircular Canal.

By SYDNEY SCOTT, M.S.

A. B., FEMALE, aged 25. This patient has suffered from bilateral otitis media for several years. In 1921 a polypus was removed from the right ear. Six months ago she began to complain of giddiness, and she developed a "fistula symptom" (vertigo on pressing the finger into the left external auditory meatus). "On turning her head suddenly to the right she would nearly fall—to the left. She had some headache, not severe, but she said that her head 'felt heavy' on the left side."

On January 12 she was admitted to St. Bartholomew's Hospital. There was muco-pus in the left external auditory meatus, and a granulation in the fundus obscuring the drum membrane. Hearing was impaired, but not lost. Compression of the air by the finger in the left meatus caused violent vertigo and *diplopia*, both eyeballs primarily rotating horizontally to the right, the excursions of the left eyeball being greater than those of the right, causing strabismus. The primary deviation was followed by return movements, and gradually subsiding "to and fro" horizontal nystagmus—in fact, the ordinary "fistula reflex symptom" associated with a labyrinthine fistula of the external semicircular canal—with this difference, that the primary movement of the left eyeball exceeded that of the right eyeball to such an extent as to cause strabismus.

On January 13 an epi-tympano-mastoid operation was performed. There was no incus. Cholesteatoma removed from antrum, aditus and epi-tympanum. Large fistula of the external semicircular canal seen. Pressure on the fistula produced slow deviation of the eyeballs (but no nystagmus) to the right, under light general anæsthesia. The fistula was not probed and the labyrinth was not explored. The cavity was lightly packed with dressings.

On January 14. No spontaneous nystagmus. Pressure with the fingers on the dressings caused no ocular movements, but release of pressure provoked marked vertical nystagmus, with primary movement of both eyeballs upwards. No strabismus.

The same reflex response was observed daily until 11 a.m. *on January* 18, when it was less marked. At 4.10 p.m. pressure on the dressings caused torsional nystagmus—that is, rotatory about an antero-posterior axis, the upper meridian rotating to the patient's right. This appeared to an observer as an anti-clockwise primary

movement, followed by a return movement clockwise on release of pressure to the dressings.

This tortional nystagmus was accompanied by lateral deviation of the head "to and fro" towards the left, then to right shoulder.

On January 19. The same reflexes obtained.

On January 20. No response.

On January 21. Direct pressure on the fistula caused lateral horizontal deviation of the eyeballs to the opposite side, as before the operation.

On January 27. The operation cavity was skin grafted, except over the fistula.

On February 4. Caloric tests. No reactions obtained with water at 115° F., or with water at 70° F., but at 45° F. the reaction was seen. The original fistula symptom still present. Pressure in the stapedial region provoked *vertical* nystagmus, the primary movement being upwards.

Discussion.—Sir JAMES DUNDAS-GRANT asked what was the position of the fistula (Mr. SCOTT: In the external horizontal canal). The case was curious, because such tremendous disturbance following the relaxation of pressure (comparable to rarefaction) was most marked when the suction was through the fenestra ovalis, which was equivalent to a fistula in the utricle rather than in the external semicircular canal. He (Sir James Dundas-Grant) had a case in which the stapes had been dislocated, and while compression caused very little disturbance, the suction rarefaction almost sent the patient off his chair. This suction action on the utricle caused vigorous movements of the endolymph in all the canals; hence the violence of the reaction. In semicircular-canal fistula one was taught that the twitch should come to the same side as the compression. But, as Mr. Sydney Scott had said, there was often great difficulty in saying in which direction the nystagmus occurred.

Mr. G. J. JENKINS (President) said that the point of great interest was that, though the labyrinth did not react to the caloric test until a very strong stimulus was used, yet nystagmus could be produced by pressure over the fistula or on the stapes. Loculation in the labyrinth would explain the interference with the defective response to the caloric test, and also by this means a pressure applied at one point might be directed to one ampulla, and this would explain the actual nystagmus by pressure on the stapes.

Mr. A. R. TWEEDIE said he was indebted to Mr. Scott, as he had examined this case the previous day. The only regrettable point was that it was not a purely unilateral case, owing to the fact that there was an active attic suppurative lesion on the opposite side. The caloric tests (Kobrak's method) gave the following results: 5 c.c. of water at 45° F. applied to the right ear induced a "normal" nystagmus to the left, after a latent period of 30 sec., and lasting 30 sec.; but, although the tympanic membrane was, of course, absent on the left side, 10 c.c. of water at the same temperature was required in this ear to induce similar nystagmus directed towards the right. The left labyrinth, therefore, was presumably hypo-sensitive. Pressure over the fistula induced a deviation of the eyes to the right (contralateral side), which was accompanied by nystagmus, the latter being inhibited when the eyes looked to the left side. Pressure on the stapes induced a vertical nystagmus, the upward movement being the strongest; but, as this was accompanied by head-nodding, the observation was made rather difficult. The responses were, perhaps, rather contrary to what one would expect, but he agreed that loculation was the probable solution of this disturbance of what one might expect to be the "normal" effect. He hoped that, later on, the effect of the rotation tests might be reported. An attempt was made to obtain the otolithic reactions, but no nystagmus or by-pointing could be elicited by alteration of the position of the head. With regard to the strabismus, he raised the question with Mr. Scott as to whether this could be due to meningitis of the sixth nerve (Gradenigo's symptom), but he understood from Mr. Scott that, in his opinion, this could be excluded.

Mr. SYDNEY SCOTT (in reply) said that after trying the cold syringe and failing at 70° F., he tried Sir James Dundas-Grant's method of employing cold air, and this produced a reaction at 45° F. in 60 sec. He was not sure whether Mr. Tweedie and he were on common ground as to the designation of nystagmus, i.e., whether the nystagmus was to the opposite side or to the same side. It had generally been agreed that when we said "nystagmus was to the right" we meant it was more marked when the eyeballs were deviated to the right and the

more rapid jerk was toward the right. In this patient one could not say the jerk was definitely more rapid to the right than to the left. He (Mr. Scott) therefore preferred to state that there was nystagmus, and that the first and primary movement was to the right, and that would correspond to what was generally described under the term "nystagmus to the left." There was not a more rapid jerk to the left than to the right. He considered the President's suggestion a very interesting one, that there might be some loculation in the labyrinth, in this patient.

Dr. W. F. WILSON wondered whether rotation would clear up the question of loculation. If so, the sooner it was done the better, before she obtained compensation.

Section of Otology.

President—Mr. G. J. Jenkins, F.R.C.S.

Hæmorrhagic Types of Ear Disease occurring during Epidemics of Influenza.

By Sir William Milligan, M.D.

During recent epidemics of influenza my attention has been drawn to certain types of ear disease which differ materially in their clinical manifestations from the ordinary catarrhal or suppurative forms with which we are all so familiar. I am well aware that the term "influenza" is a somewhat elastic one, and that, for want of a more precise diagnosis, many cases are classified as influenza which are probably nothing more than severe catarrhal attacks due to organisms of more than ordinary virulence. My remarks apply, however, to those cases occurring during an established epidemic of "la grippe," when other organs may at the same time be attacked, for example, the lungs or one or other portion of the respiratory or intestinal tract. A peculiarity of "la grippe" is that in various epidemics it shows, for reasons not yet defined, a predilection to attack one area or organ rather than another. Thus, in recent epidemics, the areas or organs of selection have been the nasal accessory sinuses, the lungs, the stomach, or the ears. Most of our knowledge of accessory sinus suppuration dates from the great epidemic of 1899, which was, in fact, a European epidemic, when Ziem wrote his now classical monograph on the subject.[1] Unfortunately for exact diagnosis and classification, the specific organism of influenza, as originally discovered by Kitasato, is difficult to find, and, soon after its initial voyage of destruction, is torn in pieces and destroyed by the all-pervading streptococcus.

For this reason, if for no other, an exact estimate of the value of clinical signs and symptoms has an especial significance, and even in the event of our being unable to find the causal bacillus, a reasonably exact diagnosis is, as a rule, possible.

The toxæmia produced by the presence of the influenza bacillus circulating in the blood has the effect of inducing a marked vasomotor paresis, of upsetting the balance of the heat centre, and, as a rule, of producing intense congestion and high temperature.

The very severe headache so often complained of is the outcome of an acute and rapid congestion of the pia arachnoid membranes with a concomitant increase of cerebro-spinal fluid and a consequent rise of intracranial pressure. This factor—the increase of cerebro-spinal fluid—is readily demonstrated by tapping the lumbar theca and noting not only the greatly increased quantity which flows out, but also the rapidity of the flow. No measure gives greater relief from the existing headache than a lumbar tap, and no measure is of greater assistance in relieving the varying degrees of serous meningitis, the invariable precursor, in my opinion, of septic meningitis, so frequent in influenzal tympano-mastoiditis. The aberrations of the heat centre are also materially kept in check, for nothing predisposes more to high temperature than sudden and fluctuating increases of intracranial tension.

In the ear we have the means of ocularly demonstrating some of the phases of acute congestion, phases which, to my mind, are sufficient clinical evidence to warrant a diagnosis of influenza, even in the absence of the discovery of the specific bacillus.

[1] *Monatschr. f. Ohrenheilk.*, 1900, xxiv, p. 341.

In the external auditory meatus the occurrence of an otitis hæmorrhagica is pathognomonic. In no other form of ear disease of which I am aware, do we find the peculiar blood-charged bullæ which we find in influenza. These bullæ are usually situated on the postero-inferior meatal wall close to the annulus tympanicus. They vary in size, are thin-walled, and have a deep congested hue or an almost livid colour. Situated as they are, just under the cutis, they are prone to rupture spontaneously and to discharge their contents *per meatum*. At other times the exudation becomes gradually absorbed. These bullæ are found not only on the meatal walls, but also upon the surface of the membrana tympani itself, and at times those on the osseous walls of the meatus coalesce with those on the membrana tympani.

On the membrane there may be several such bullæ of varying size, and usually with a deeply congested appearance. They may occur quite independently of any middle-ear lesion, or may be part of a panotitis. These bullæ also are prone to rupture and to discharge their contents. At other times the contents become absorbed, followed by a certain amount of desquamation, while, in exceptional cases, perforation of the membrane from pressure erosion may result.

The treatment of such cases is extremely simple and consists in puncturing the bullæ and allowing the contents to escape, and then dusting the meatus with some antiseptic powder and inserting a strip of sterile gauze. The point of importance is to recognize that the condition is often an epidemic one and of influenzal origin.

In the middle-ear cleft, and more especially in its tympano-antral segments, the destructive force of the influenza microbe is seen in all its glory. Here again, the bacillus is extremely difficult to isolate, as, after its first energetic attack, it readily capitulates to the onslaught of the ubiquitous streptococcus. The intense congestion of the middle ear which it frequently produces—a true otitis media hæmorrhagica—is very obvious on inspection: a fiery and red drum-head is seen with occasional bullæ of a dark bluish colour on its posterior superior segment, œdematous and without landmarks, actually at times pulsating as a whole, and invariably giving rise to acute suffering. The congestion is much more acute and painful than that present in the usual types of middle-ear catarrh, and its destructive effects, so far as the contents of the middle ear are concerned, are much more serious.

To prevent extension to the posterior end of the middle-ear cleft and to save the integrity of the ossicular chain, an immediate and free incision should be made through the membrane, and free drainage maintained. A peculiar feature following incision is that the pain is not immediately relieved—as it practically always is after incision in pyogenic otitis media—but may persist for a day or two. If no incision be made, the membrane will rupture and as a rule extensive loss of tissue follows.

The facility with which extension takes place to the mastoid antrum and adjoining mastoid cells is very remarkable, and the special predilection for an apical mastoid abscess characterizes the organism as one which prefers "the darkness rather than the light."

With the exception of diabetic mastoiditis, I am unaware of any inflammatory affection which produces such rapid destruction of bone as happens in influenzal mastoiditis. Time after time on opening the mastoid cells in these cases I have found such extensive destruction of bone that the posterior antral wall has been absorbed and an extensive area of cerebellar dura exposed. It is in cases of this type, fulminating and destructive, that headache is especially severe, the initial temperature unduly high and the patient's mentality unduly depressed or unduly exalted, a condition due in all probability to a concomitant and sudden increase of intracranial tension, or, in other words, to a serous meningitis.

The tendency to the formation of an apical mastoid abscess is difficult to explain,

as infection apparently passes by the way of the antrum and adjoining mastoid cells without necessarily doing more than producing an acute osteitis.

On many occasions I have found a large apical cell full of pus and a barrier of microscopically healthy bone between it and the mastoid antrum, with no trace of pus in the antrum itself. The selective power of the infective organism is certainly remarkable. A point of clinical importance is that in these cases the "dip" of the postero-superior meatal wall—*la chute*—pathognomonic of infection of the marginal mastoid cells, is frequently absent, the infection being, in the first instance at any rate, purely apical, while another useful aid to diagnosis is an early and slight œdema, not over the surface of the mastoid apex, but in front of its anterior wall, immediately behind the lobule of the ear and tending to obliterate the lower end only of the retro-auricular groove.

I am almost certain that in many of these cases with objective signs of severe congestion, there is at the same time an evanescent pia-arachnitis. The relief which follows lumbar puncture, with the escape of a perfectly clear fluid under tension, is, I hold, evidence of its presence. Moreover, if not withdrawn, it is liable to become infected, as tension seems, for some inscrutable reason, to favour organismal attack and victory.

My experience in these cases has taught me the value of early interference, of anticipating the course of pathological events, of at once draining or removing the focus of infection, and of "letting off steam," so to speak, by a lumbar puncture, where pressure, as gauged mainly by the existence of severe headache, appears to be rising. At the same time, my experience is that it is not safe to trust simply to opening and draining the apical cell or cells, but that the bone between the cells and the mastoid antrum should be removed, in other words, that the ordinary Schwartze operation should be performed.

In the internal ear the hæmorrhagic effects of influenza, although not ocularly demonstrable, are clinically obvious enough. Masked, as they are so often, however, by the presence of a concomitant otitis media, they are liable to escape notice until, perhaps, months afterwards, when the persistent tinnitus and progressive deafness of the nerve type call attention to the fact that all is not well.

How many of us have not seen cases of nerve deafness definitely and specifically attributed to an attack of influenza? What the exact pathology of these cases is, it is impossible to say, as the disease is not of itself a fatal one, but working on analogies and careful clinical tests, I venture to say that it is due to hæmorrhagic effusion into the cochlea, with resulting destruction of certain portions of the end organ, and toxic infection of the auditory nerve itself.

Many years ago, Professor John Cameron and myself, working in collaboration, pointed out that the cytoplasm of the auditory syncytium does not become entirely transformed into nerve fibrils, that a portion—the undifferentiated portion—remains as the medullary sheath, and that just before the syncytium passes through the external limiting membrane of the otic vesicle to become continuous with the cytoplasm of the neuro-epithelium, it becomes attenuated and freed from the nuclei of the neuroblasts just as happens at the central end of the nerve where it enters the hind brain. In other words, where neuroblasts are absent there is no neurilemma. It is at this point, which has been named by Orr and Rows "the vulnerable point," that toxins readily enter the nerve tissue, and, indeed, sensory nerve degeneration actually commences. My contention, therefore, is that the blood circulating in the hyperæmic labyrinth, charged with the toxins of the causal bacillus, sets up a neuritis which is progressive and degenerative, and is, in fact, responsible for the slow but steady loss of hearing in these cases.

Clinically, it is of the utmost importance to recognize the symptoms of an early sero-sanguineous, influenzal labyrinthitis, and to treat it vigorously by local depletion, by lumbar puncture, and by the repeated subcutaneous injection of pilocarpine, in

order to promote absorption and thus relieve the increased intralabyrinthine tension so conducive to the passage of toxins through the "vulnerable point"—or point of least resistance—of the auditory tract.

Discussion.—Mr. G. J. JENKINS (President) said that during the last few years in this country there had been epidemics of influenza associated with otitis externa hæmorrhagica; three years ago he (the President) had had five cases of this kind within a short time and had believed that he had met with a new disease, but had subsequently found that there was a clinical description of the condition in Politzer's work. In most of the cases he (Mr. Jenkins) had seen the hæmorrhagic blebs had been quite large, almost filling up the meatus, though usually one could see the tympanic membrane beyond, almost normal in appearance. In some cases of this group, however, he had found all the signs and symptoms of the condition, without the hæmorrhagic blebs in the meatus, but in these latter cases there was always a redness of the meatal wall, often with slight injection of the margin of the tympanic membrane. In addition to the meatal changes, there was commonly pain and tenderness in the mastoid region; in a few cases the patient complained of vertigo, and there was definite nystagmus to the same side with indefinite Rombergism. The most striking feature was that with all these sometimes severe symptoms and marked changes in the meatus, there had been the slightest, if any, affection of the hearing. Occasionally the condition was associated with cranial complications. In two of his (the speaker's) cases there had been cerebritis, and in one of these the patient died from thrombosis of the longitudinal and lateral sinuses. The suggestion was that some cases of persistent nerve deafness or labyrinthine disorder were due to this general affection of the region. The hæmorrhagic blebs, if kept clean, often dried up without suppuration. His (Mr. Jenkins') method was to protect the ear or, at most, to put a few drops of perchloride lotion into the meatus. As the condition was associated with influenza and the blebs had not an inflammatory character (never went on to suppuration), he (the President) thought the condition was not due to infection with the ordinary pyogenic organism, and that it might be caused by one of the filter-passing organisms. An attempt had been made to make cultures with ordinary pyogenic organisms from the blood of the blebs of the three epidemics; in some the results were negative, but in others streptococcus or pneumococcus was found. He (Mr. Jenkins) had consulted with Dr. Perdrau, an authority on filter passers, who injected some of the fluid from a bleb under the skin, and some of the cerebro-spinal fluid of an affected patient, into the brain of a rabbit. The injection did not produce the reaction produced by an injection of the herpetic virus, establishing the fact that the disease was not a herpetic eruption in the ordinary sense, and that there was no relationship to herpes labialis. He regarded the suppurative process associated with this condition as secondary, just as in the case of antrum infection after influenza. Among the cases being watched at King's College Hospital last week there was one of typical otitis externa hæmorrhagica, and at a later stage it was decided that it was an ordinary suppurative mastoiditis; it was difficult to know when the process became suppurative. In the last three years there had been a number of cases at King's College Hospital.

Mr. SYDNEY SCOTT said that he had observed that the bullæ which Sir William Milligan had described occured in both the mildest and most grave forms of otitis media. There were cases in which the patient would come to the out-patient department with a hæmorrhagic bulla on the tympanic membrane, or in the meatus, which cleared up under the simplest treatment. On the other hand, they met with the same condition in otitis media with fulminating lepto-meningitis. He (Mr. Scott) had been particularly interested in Sir William's reference to the nerve deafness sometimes following the influenzal otitis media cases which showed signs of true nerve deafness. It might well be, as Sir William had suggested, that effusions took place in the cochlea similar to those seen in the drum membrane or meatal wall.

Mr. E. D. D. DAVIS said that two definite clinical types were under discussion. One was the acute streptococcal otitis media, of which there had been a considerable epidemic this year, with a high temperature, an infection of nose and throat, and occasionally tonsillitis. When examining the ear in these cases, blebs were seen on the drum, and after puncture of the drum there was a profuse blood-stained serous discharge. This otitis was considered to be caused by a hæmolytic streptococcus. In the other type the inflammation seemed to be confined to the auditory meatus and was an otitis externa. Sometimes a bleb would burst and the serous discharge appear to come from the middle ear, resulting in the mistaken

diagnosis that the drum had ruptured and that puncture was unnecessary. In cases of the otitis media described above, the drum should always be punctured to enable free drainage to take place, and he (Mr. Davis) had never known puncture of the drum do harm. When pain persisted after puncture it was difficult to decide whether a mastoid operation should be done or not. He (the speaker) usually waited for forty-eight hours, and if in that time the patient's condition had improved, the mastoid was not opened.

Mr. J. F. O'MALLEY said he remembered that otitis media met with during an influenza epidemic was associated, in many cases, with hæmorrhage. Up to the severe epidemic of 1918, which had been marked by pneumonic complications of a fatal type, he (the speaker) had been at a loss to account for this hæmorrhage. Then it had been reported that there was a common association of *Streptococcus hæmolyticus* with the bacillus of influenza, and he (Mr. O'Malley) thought that that association had been perhaps the chief factor in an epidemic of ear diseases with hæmorrhage occurring at Woolwich at the end of 1918. He (the speaker) had sought, by examination of the fluid, for a proof of this theory, but only in two or three cases could he get the *Streptococcus hæmolyticus* in secretion drawn directly from the middle-ear cavity.

Sir JAMES DUNDAS-GRANT said that the appearance of the tympanum in this condition was apt to be unduly alarming; it was out of all proportion to the actual mischief, for on testing the hearing it was found to be almost perfect. This disproportion should put the observer on his guard. He (Sir James) had sometimes experienced difficulty in diagnosing between this bullous condition and disease in the external attic. Sometimes there was a bulging from the attic which looked like a sac, but it was infiltrated tissue. If pricked it still remained there. It could be snared off, though even if that were not done it often subsided. There was, however, always at least some slight loss of hearing in attic disease. It was very important to remember the apical infections in which the mastoid might be opened and at first nothing be found. Yet one knew something was there, and it was not until one came to the apex that one found a large cell containing a considerable amount of pus. On evacuating that, all the symptoms subsided. Politzer had found the same condition prevalent in an epidemic in Vienna. Why should cortical or apical cells be selected? It depended largely on the anatomical construction of the individual mastoid process. There was less surface for phagocytosis on the walls of one large cell than on those of a number of small ones with dissepiments. Bezold had suggested, and it was quite possible, that the narrow communication between the antrum and the large cells had become sealed up by inflammation. He (the speaker) brushed out the meatus with spirit to render the outside aseptic, and then introduced drops such as the late Mr. Hunter Tod had described, namely, morphia 1 part, cocaine 2 parts, phenol 3 parts, to a drachm of almond-oil or glycerine, above all keeping the patient at rest, to prevent the condition from becoming a major one.

Mr. NORMAN BARNETT said that after an epidemic of influenza a case was sent to him in which there was apparent hæmorrhage into the semicircular canals; there was no symptom of hæmorrhage elsewhere. All other possible causes of hæmorrhage in this region were excluded; under treatment absorption gradually took place and the symptoms passed off.

Mr. W. M. MOLLISON said he had seen epidemics of so-called influenza otitis externa, and he had never had the courage to leave the membrane unincised. He had seen another condition in which blebs occurred, namely, in the terminal stages of very severe illnesses; a few days before death he had found the same variety of bleb in the meatus.

Mr. A. R. TWEEDIE said that he looked upon this condition as essentially a middle otitis, illustrating the point that the subperiosteal space of the bony meatus was in anatomical continuation with the subperiosteal space of the tympanum, and that thus, in this respect, the bony meatus really represented an extension of the middle ear. This point was also demonstrated in the case of acute otitis media with distension of the posterior meatal wall and adjacent membrane; it supported the old instruction as regards paracentesis, to the effect that the knife, after incising the membrane, should be carried backwards along the posterior meatal wall. The method of applying a local anæsthetic to the middle ear, as suggested by Neumann, was also dependent on this anatomical condition.

Mr. G. J. JENKINS (President) said that an attempt should be made to distinguish whether it was a suppurative or a non-suppurative process, or whether a suppurative process was engrafted on to another condition.

Sir WILLIAM MILLIGAN (in reply) regretted that no speaker had dealt with the theory of nerve-infection which he advanced in the paper. He considered that in influenza epidemics much nerve damage was frequently caused; there was a weak point in the sensory nerve tract; it could be seen developmentally, it was evident histologically, and experimentally it could be proved by the introduction of capsules containing septic material in the neighbourhood of sensory nerves, when the degeneration was found to start at that particular point where the neurilemma was absent, as he (Sir William) had described, and where β-neuroblasts ceased. What he wished to suggest was that those cases of nerve deafness were really toxi-hæmorrhagic in origin, and that though the organism could not be found (it might be a non-filtrable virus) there was evidence that it could produce much toxæmia. If the commencing degeneration at the vulnerable spot was to be avoided, it was necessary to be more alert in recognizing early internal ear disease. He wished particularly to urge the use of pilocarpine to absorb the rapid exudate into the cochlea.

Sir James Dundas-Grant's observation on the anatomical condition of the bone was probably correct. It was difficult to explain why there should be such a predilection for the apex, but such there certainly was. He (the speaker) had not diagnosed hæmorrhage into the semicircular canals as a separate entity. He did not think the temporal bone was developed in the way Mr. Tweedie had indicated. He (the speaker) believed that there was a squamo-zygomatic and a petro-mastoid segment, and that between the two the middle-ear cleft ran up to what should be called the tympanic antrum.

The condition he (Sir William) had described was, he believed, a disease *per se*, due to a micro-organism which was difficult to find, but the manifestations of which were very evident. If otologists were on the *qui vive* for these cases and took active measures by early drainage, depletion, and repeated lumbar puncture, meningitis would often be avoided as well as much nerve deafness.

Report on Specimen from Case of Cerebellar Abscess shown at the Meeting held December 5, 1925.

By T. H. JUST, F.R.C.S.

SPECIMEN from a child, a girl, aged 7. Chronic suppurative otitis media left side for years. Granulations in the tympanum, free discharge. Child admitted to hospital because she was "seedy." No cerebellar signs present. No nystagmus or inco-ordination. The child walked up to hospital.

Whilst in hospital the pulse- and respiration-rates and the temperature were normal. Patient complained of slight intermittent headache. Lumbar puncture produced cerebro-spinal fluid clear and not under increased pressure. Patient died suddenly in bed, thirty-six hours after admission.

Temporal bone (also shown) shows three erosions to the dura mater. One into the middle fossa, and two into the posterior fossa. One behind and one in front of the lateral sinus. That in front of the sinus communicated with the abscess. At this point only was the dura mater adherent to the skull and to the brain.

I am indebted to Dr. J. G. Greenfield for the preparation of the specimens and the pathological report.

Cerebellum.—The edge of the abscess is five-eighths of an inch (1·5 cm.) from the dentate nucleus. The tissue between shows practically no evidence of inflammation, only slight neuroglial hyperplasia, but there is some perivascular infiltration at a distance from the abscess, even internal to the dentate nucleus. This is altogether a *mononuclear* infiltration. In the actual wall of the abscess there is considerable formation of fibrous tissue, the meshes of which are filled with inflammatory cells, polymorphonuclears, lymphocytes and plasma cells, as well as many larger phagocytic and fat-containing cells.

The abscess is evidently of comparatively recent formation since (1) there is nowhere a dense fibrous tissue wall, and (2) although the pus-cells are degenerated

they have nowhere lost their nuclear staining. At the same time the amount of new connective tissue and the neuroglial reaction suggest that it has been forming for more than a week.

It is an interesting case, as the patient died symptomless. Dr. Gordon Holmes, in his work on cerebellar localization, found that with a purely cortical wound of the cerebellum, except for an immediate giddiness which passed off in a few hours, there were no cerebellar signs later on. The abscess in this case is purely cortical, and on section there is seen to be five-eighths of an inch distance between the abscess and the dentate nucleus.

Discussion.—Mr. G. J. JENKINS (President) said this case was of such great interest that it deserved full discussion, but the hour was late. Was it certain that this condition was not tuberculous? (Mr. JUST: I have not tested it.) It would be well worth while to make the investigation. There was a tendency to speak rather loosely of raised pressure, and there should always be the statement whether the pressure was measured with a manometer.

Mr. JUST (in reply) said that the house surgeon had measured the pressure of the cerebro-spinal fluid in this case, and had reported that there was no increase.

Section of Otology.

President—Mr. G. J. Jenkins, O.B.E., F.R.C.S.

Gradenigo's Syndrome.

By H. G. Estcourt, M.B., B.S.

(ABSTRACT.)[1]

In 1904 Gradenigo published a paper founded on five cases recently under his care, all of which had shown that combination of signs and symptoms ever since known as Gradenigo's syndrome. In the course of an acute otitis media, usually in a young patient, and about a month after the onset, severe pain developed over the same side of the head and face, and was followed at a variable interval by diplopia due to a paresis or paralysis of the homolateral abducens nerve. In some of the cases paracentesis or a mastoid operation was performed, but in others there was no operative interference at all. In one of the cases death took place from a spreading meningitis a fortnight after the appearance of the syndrome, and from the study of this case Gradenigo suggested that the syndrome was caused by a circumscribed lepto-meningitis at the apex of the petrous bone.

In 1908 Baldenweck, and in 1910 Perkins, published articles confirming Gradenigo's theory. One of Perkins' patients recovered immediately after a mastoid operation had been performed, and this despite the fact that the mastoid process did not appear to be diseased. In 1918 Wheeler, a New York ophthalmologist, described two cases in children, in one of which the patient recovered immediately after the operation, while in the other the condition gradually cleared up without any operative interference.

In 1924 Just described a typical case occurring seven weeks after a slight attack of otitis media. There was no mastoid tenderness or swelling, but it was decided to operate on account of the eye symptoms. The whole of the mastoid process was found to be infected, and behind the external semicircular canal an infected gallery of cells was found running in towards the tip of the petrous bone. Three days after operation the sixth nerve paralysis had completely disappeared.

In 1921 Mollison reported a case having some of the signs and symptoms of Gradenigo's syndrome. Pus was found in the mastoid, but there was no infected gallery of cells running to the petrous tip. The child ultimately made a complete recovery.

In the summer of last year Mr. Cleminson had a case under his care. The characteristic syndrome developed a month after an attack of acute otitis media. At operation the mastoid was found to be healthy. Convalescence was gradual but complete, the pain disappearing a fortnight after operation, and the paralysis a little later.

Signs and Symptoms.

Most of the signs and symptoms have already been mentioned. The pain usually precedes the paralysis. It is often extraordinarily severe. Spasm or paralysis of the muscles of mastication may occur, due to involvement of the pars intermedia of the trigeminal nerve. There may be hyperæsthesia, or even anæsthesia, over the

[1] This paper will be published in full in the *Journal of Laryngology and Otology*.

area in which the pains occur. Herpes has been recorded. Optic neuritis is absent, and the only abnormality to be found in connexion with the cerebro-spinal fluid is that it may be under increased pressure.

The many cases in which there has been found a perfectly healthy mastoid at operation prove that Gradenigo was correct in stating that the syndrome could arise from an uncomplicated otitis media. Wheeler reports a case of external rectus paralysis occurring five days after the opening of boils in the external auditory meatus. There was no sign of middle-ear disease, and the Wassermann reaction was negative.

Pathology.—Anatomical Considerations.

Gradenigo based his theory of a purulent exudate at the petrous tip on the fact that in one of his cases the patient died from meningitis. But we now know that in nearly all these cases the patients ultimately recover, and this fact suggests that it is a serous rather than a purulent exudate which involves the fifth and sixth nerves. This theory is confirmed by the fact that often there is no alteration in the cerebro-spinal fluid, though it may sometimes be under increased pressure.

The reason why the fifth and sixth nerves may alone be affected by this inflammation is a purely anatomical one. The Gasserian ganglion lies in a hollow near the apex of the petrous pyramid on its antero-superior surface. The sixth nerve is also in direct contact with the petrous bone, and in its course, just before it enters the cavernous sinus, its position is marked by a small groove on this bone. Stretching over this groove, from the apex of the posterior clinoid process to the petrous bone, is the petro-clinoid ligament. This ligament is always very firm, and often undergoes partial or complete ossification. The sixth nerve passes under it, and in this position is therefore completely surrounded by unyielding structures. It is easy to see that even a small inflammatory exudate or œdema at this point would be likely to interfere with the function of the nerve. No other nerves are so intimately related to the petrous tip as the fifth and sixth. The third and fourth nerves, which are the next nearest, are throughout their course at an appreciable distance from the bone, and enter the cavernous sinus much further forward than the sixth nerve.

We have now to consider how the infection reaches the tip of the petrous bone. Perkins describes the following routes:—

(1) The sublabyrinthine route extending from the tympanum below the labyrinth and internal auditory meatus to the petrous tip.

(2) Along the small veins beneath the dome of the superior semicircular canal, to reach a layer of cells lying above the internal auditory meatus.

(3) By eroding the thin floor of the tympanic cavity so that infection might reach and spread along the carotid canal.

(4) By the layer of cells extending along the Eustachian tube. In connexion with this Mr. Cleminson has suggested that possibly the infection passes directly along the canal for the tensor tympani muscle and then through the suture between the sphenoid and petrous bones. The anterior extremity of the canal for the tensor tympani muscle is nearer the Gasserian ganglion than the sixth nerve, so this would explain why the pain precedes the paralysis.

Treatment.

We have seen that most cases end in recovery even if no operation is performed. Moreover, in many cases there has been a perfectly healthy mastoid at operation. These facts suggest that, provided the patient can be watched and there are no obvious signs of mastoid disease, the ordinary treatment for otitis media should be tried. If there is no improvement operation may then be considered, but I think I have described a sufficient number of cases to show that there is no need to rush at an operation the moment the patient is first seen.

Discussion.—Mr. SYDNEY SCOTT said that the cause of ocular paralysis in these cases had been considered at the National Hospital and other hospitals for nervous diseases. One point Dr. Estcourt had not mentioned was the anatomical arrangement of the blood-vessels in relation to the sixth nerve in that part of the nerve between the pons and its entrance into the walls of the cavernous sinus; nor had he referred to the fact that a branch of the cerebral arteries sometimes looped beneath the sixth nerve in that situation. With an excess of cerebro-spinal effusion into the basal cisterna the brain-stem was displaced, causing a kink in one or both sixth nerves. For a time, he (the speaker) had thought, with Dr. Howell, that this was the explanation of Gradenigo's syndrome. Rapid recovery from paralysis in a few hours after lumbar puncture, and the recurrence of the paresis with return of headache, favoured this view. Few cases, in comparison with the frequency of Gradenigo's syndrome, proved fatal. In some, such as Mr. Just's, there were apical petrous cells causing a localized lepto-meningitis, but these belonged to the relatively uncommon fatal group. He (Mr. Scott) considered that there were two quite different causes of the syndrome in each group.

Mr. J. F. O'MALLEY said that he (himself) had had two cases of the kind, one in 1916, the other during the present year. The first was an acute mastoid on which he had operated, in the other there were no mastoid symptoms and he had not operated. The second patient was a child, aged 9, with a two months' discharge from the right ear. There had been diplopia five days: the discharge had yielded a pure growth of *Streptococcus hæmolyticus*. Three days later the temperature had suddenly risen to 104° F., albumin and pus had been present in the urine; and the only organism found had been *Staphylococcus albus*. Later on, although the right rectus was regaining power, there had been another rapid rise of temperature to 103° F. Next day, however, the temperature fell again. Albumin had then been present in the urine. Two days later a specimen of urine obtained by catheter had contained neither cells nor organisms, and the ocular movements had become normal. He (Mr. O'Malley) had not considered it justifiable to open the mastoid, as there had been no indication of mastoiditis. The syndrome might be due to a blood infection, and explicable on these lines.

Mr. T. JUST said he also thought that if the patient was not seriously ill there was no reason to urge an operation. He (the speaker) had had such a case, the patient being a boy who had subacute unilateral mastoiditis which had necessitated a Schwartze operation. A week later sixth nerve paralysis had developed on the same side, and he (Mr. Just) had considered the case to be one of Gradenigo's syndrome. He had examined the wound again to assure himself that he had not left any cells undrained. A week later contralateral facial paralysis had developed. He (Mr. Just) had found it very difficult to associate the two conditions. A neurologist had then seen the boy and had diagnosed encephalitis lethargica. The patient had recovered from the cranial nerve paralysis. This disease should be remembered when there occurred a paralysis of a cranial nerve or nerves for which it was difficult to account.

Mr. G. J. JENKINS (President) said he thought that eventually two distinct conditions of intracranial trouble would be recognized: the first connected with the cerebro-spinal fluid; the second coming from the petrous bone. The latter might affect the fifth cranial nerve first.

[*May* 8, 1926.

Mosher's Method of Skin Grafting.

By LIONEL COLLEDGE, F.R.C.S.

Dr. MOSHER'S paper, printed in the *Transactions of the American Otological Society*, 1925, was sent to me in order that I might try his method, and I have found it satisfactory. The trouble with moulds and stents is that a mould is solid, and when a solid cast of a cavity is made and covered with a graft, the wound must be re-opened in order to remove the stent or the mould. The method was used at Sidcup for grafting in cases of mouth wounds, and in these the trouble attendant on removing the stent did not arise.

Dr. Mosher has been using this method ten years and has found it satisfactory. It consists in taking strips of gauze soaked in paraffin wax and then folded so as to form a hollow cone. The cavity being ready, a hollow mould of this gauze is made.

The gauze should be dipped in warm water first to soften the paraffin. The Thiersch graft is wrapped round the mould, it adheres satisfactorily, and does not curl up at the edges. The mould having previously been made the exact shape of the cavity can be replaced without difficulty. There is no irritation, and there appears to be no sepsis produced by the foreign body; you can leave the mould in position seven, even ten days, and if a large opening through the meatus has been made there is no trouble in bringing this hollow mould together and drawing it out through the meatus. I have here one which I removed post-aurally, in a case in which I had reason for leaving the wound open posteriorly. You can see the exact mould of the radical cavity.

Discussion.—Mr. G. J. JENKINS (President) asked what advantages Mr. Colledge's method had over other methods.

Mr. COLLEDGE (in reply) said he did not think one should make any extravagant claims for the method. An exact mould of the cavity was obtained, therefore the graft could be applied with accuracy to the whole area required, and the edges did not roll up. When the mould was removed, the graft was not disturbed. The paraffin seemed to have a soothing effect on the wound, and there was not the fœtor which followed the use of ordinary plain or cyanide gauze.

Case of Acute Mastoiditis.

By T. JEFFERSON FAULDER, F.R.C.S.

BOY, aged 16. Right complete mastoid operation, February 23, 1925.

Previous History.—Removal of tonsils and adenoids, 1914; operation satisfactory. Right earache every spring, with discharge, recovering each time till present illness. A history of "pneumonia" in childhood, and of "hip disease."

At operation osteomyelitis of the whole right mastoid process was found. Lateral sinus and dura mater of middle fossa seen, but not interfered with.

The interest lies in the course of the case. Before operation the temperature had risen to 102° F. The next day it rose to 105° F., and thereafter there was pyrexia with very occasional remissions for six weeks.

Other points to notice are: (1) Extreme tenderness over the whole right sterno-mastoid muscle lasted a week. (2) There was slight pain over the left lower chest for the first week. (3) In the second week slight transient pain over right lower chest. (4) Respiration rate 32-24 the whole time.

Examination of the blood was negative, except that it showed "secondary anæmia of the chlorotic type" (Dr. H. Pritchard).

Examination of chest was negative until the fifth week, when dullness was detected at the right base (Dr. Pritchard and Dr. Turnbull).

A dull patch was shown by X-rays. At the beginning of the sixth week patient suddenly coughed up 4 oz. of pus, and rapidly got well.

NOTES.

(1) The temptation to re-investigate lateral sinus and jugular vein was great.

(2) Assuming that procedure successfully completed, credit might have been claimed for it for effecting the final cure.

(3) The history of "hip disease" raised the possibility of tuberculosis as an explanation of the chart.

(4) X-ray examination made earlier might have helped the diagnosis.

(5) The suggestion is made that there were weak areas in both lungs, and that one of these was so affected by inhalation (at operation) as to produce an abscess.

This case illustrates rather well the type of dilemma which may occur in aural surgery, and the anxiety which it may cause. The tenderness over the sterno-

mastoid on the side operated upon was very marked, and I think it was due to free detachment of tendon from the mastoid process. The pain in the lower chest was transient, and we found nothing at the time to explain it. Other confusing points were the " hip disease " and the pneumonia in the earlier history.

Discussion.—Mr. M. VLASTO said that some years ago he (the speaker) had had a case with similar features. A man upon whom a Schwartze operation had been performed had, after operation, for several days recorded an evening temperature of 104° to 105°. There had been no rigors, but pain and tenderness were present over the neck on the side of the wound. The question had arisen whether to re open the wound and investigate the lateral sinus for the presence of a septic thrombosis. Fortunately the condition subsided by lysis and further recovery was uneventful.

Mr. Mollison had suggested that the trouble was probably due to infection of the sheath of the sterno-mastoid. Possibly, in detaching the sterno-mastoid from the bone, he (the speaker) had torn some of the fibres across.

Mr. J. F. O'MALLEY said that the case was of special interest, because of the anxiety as to the cause of the pyrexia in such circumstances. As Mr. Faulder had said, one felt inclined to operate on the lateral sinus, as the mastoid had already been opened. He himself had had last year a similar case in which an ordinary simple mastoid operation had been performed. About a week afterwards the wound had broken down and the temperature had risen suddenly. He (the speaker) had not been satisfied that there was anything exceptional in the mastoid, but there was enlargement of glands under the sterno-mastoid muscle, and for a day or two he had considered that this was sufficient to account for the temperature, and he had refrained from operating further. A week later nasal speech had developed in the patient, although when swabs taken from the throat had been examined the results had been negative. Still, there must have been a Klebs-Loeffler infection, which had produced paralysis of the palate.

Sir JAMES DUNDAS-GRANT said that the title of this case should be amplified so as to indicate its extreme interest. He (Sir James) would like to know what was the condition of the sinus and the dura mater when exposed. He thought that a portion of thrombus had been carried from the lateral sinus, and that the embolus had reached the lung, where it more usually arrived in chronic cases. In acute cases minute emboli were carried through to joints or other parts.

Mr. HAROLD KISCH said that on several occasions he had been faced with the difficulty of deciding whether a high temperature was to be explained by lateral sinus thrombosis or by pulmonary complications. He had had several cases in which there had been acute infection of the lung by the pneumococcus and infection of the ear at the same time. One such case was that of a boy aged 17, who had been accustomed to diving and swimming. He complained of acute pain in his ear, and when he (the speaker) had first seen him, was obviously suffering from acute mastoiditis. He also complained incessantly of a " deep " pain in his chest, had a temperature of 105° F., and was very ill. A physician had seen him, and had been unable to find any pathological evidences in the lungs. He (Mr. Kisch) had performed a mastoid operation, and had exposed the lateral sinus over much of its length. It had been pulsating, and, so far as he could tell by the naked eye, had been normal. He had left the wound open in order to observe the sinus. For five days the temperature had continued to be 105° F. On the fifth day a crisis had occurred, and tubular breathing could be heard. That patient had afterwards gone through the ordinary course of pneumonia and convalescence. It was important in such cases to expose the sinus freely at the first operation and to keep it under observation.

Mr. FAULDER (in reply) said he was tempted to interfere with the lateral sinus again. Two other members of the Section were of opinion that if the clinical condition did not improve rapidly that should be done, and also that the jugular vein should be tied. In answer to Sir James Dundas-Grant: there had been no indication for interference with the lateral sinus or with the dura; he only exposed them by accident so as to remove the diseased mastoid process. There had been no rigor, and he would have expected rigor if there had been a thrombus or a pyæmic abscess.

Case of Cystic Swelling behind the Ear: for Diagnosis.

By D. Winifred Hall, M.B., Ch.B.
(introduced by Nicol Rankin, M.B.)

Patient, aged 23. Came to Central London Throat Hospital with right chronic suppurative otitis media. There is also, behind the same ear, a cystic, translucent swelling, attached to deep structures and occupying a depression in the bone, that has been there "as long as she can remember."

Discussion.—Mr. G. J. Jenkins (President) said this case was of great interest, and it was a pity a skiagram had not been taken to complete the record. The swelling did not feel like a dermoid, nor was it the usual situation for such a cyst. In his (the President's) opinion, it had rather the appearance of a meningocele. He would suggest that elastic pressure should be applied for two or three hours, to see whether that caused any alteration in the tension or size. It was important that the title of the case should be correct, because if the swelling proved to be a meningocele that condition was rare in this site.

Mr. Lionel Colledge said that he agreed with the President as to the nature of this case. He said that years ago a child had come to his (the speaker's) out-patient department with a swelling, obviously not inflammatory, behind the ear. Its character was different from the swelling in this case, as it was semi-solid in consistence. He (Mr. Colledge) had removed it, and had found a very small hole at the bottom, leading to the mastoid process. Mr. Howell Evans had photographed it at the time, and had suggested that it was a dermoid which had developed from the otocyst. The minute canal at the bottom accorded with this view, and when the tumour was cut open it did not contain fluid as the swelling in the present case apparently did, but was full of solid epithelial débris, clearly a dermoid.

Sequestrum of Semicircular Canals.

By W. J. Macdonald, F.R.C.S. (introduced by Archer Ryland, F.R.C.S.).

Woman, aged 41. Left radical mastoid operation, September 24, 1921: at that time complete loss of hearing, giddiness, slight horizontal nystagmus to left. Granulations in antrum, and extensive destruction of ossicles.

Continuous discharge. In 1925 vertigo and left facial paralysis.

March 4, 1926.—Readmitted. Left facial paralysis. Horizontal nystagmus to right. Complete deafness (left) and loss of labyrinth responses (left).

Sequestrum removed. Posterior wound closed by sliding flap.

Wassermann negative.

In spite of the negative Wassermann reaction, the patient had four miscarriages before she produced a live baby.

Discussion.—Mr. G. J. Jenkins (President) said that this interesting specimen suggested that the inflammation which destroyed the labyrinth had occurred in very early life. He (the President) could not imagine that a suppurative process would, in an adult, give rise to a separation of the capsule of the labyrinth. He would have expected to find a mass sequestrum rather than the specimen shown. He suggested that there had been a suppurative process in early life, and that the destruction of the labyrinth had not been recognized when the radical mastoid operation was done a few years ago.

Mr. Macdonald (in reply) said that so far as he knew the mastoid condition four years ago had not been preceded by any labyrinthine storm. The illness had been acute, and the operation almost immediate. The facial paralysis had begun only a year ago, with epiphora of the eye and inability to close it. She had had no further symptom of facial paralysis until seven days before readmission to hospital this year, and then she had noticed that she was biting her lower lip on the left side. When admitted, she had complete facial paralysis on that side, and, so far, there had not been any improvement.

Mr. Jenkins (President) said that the absence of a labyrinthine storm seemed to confirm the idea that the destruction of the labyrinth occurred in early life.

Section of Otology.[1]

President—Mr. G. J. Jenkins, O.B.E., F.R.C.S.

Cystic Serous Meningitis.

By G. J. Jenkins, O.B.E., F.R.C.S. (President).

For want of a better I use the title of a paper written by Bing in 1911. Bing, Bárány, and others, have described cases of accumulation of subarachnoid fluid, in relation to the anterior aspect of the cerebellum. In the following cases the symptoms and signs spoken of by Bárány were not demonstrable, but these cases do indicate that some pathological condition does occasionally occur.

The cases are as follows:—

Case I.—Miss N., aged 30.

First seen January, 1925. Complaint: giddiness, headache in the neighbourhood of the left ear and occipital region and discharge from the ear.

She had a mastoid operation on the left side in 1914 in another London hospital for chronic otorrhœa. Discharge disappeared, but recurred in July, 1924. Pain off and on since July, 1924. Tinnitus, steam escaping, intermittent since 1914. Deafness marked since operation. Always a slight degree of vertigo since July, but has had severe attacks, and on two or three occasions has fallen. Had the feeling of falling to the left. Left occipital headache more or less constant.

Right ear: some pain, and discharge in 1925. Tympanic membrane cicatricial, but no perforation.

Left ear: radical mastoid been performed. Granulations in region of antrum.

Weber left. Bone conduction (C. 2 fork) diminished in both ears equally. Rinne double negative to C. 2 fork. Complete testing with Edelmann forks and monochord not attempted. Conversational voice, right 6 ft., left 2 ft.; whisper, right 3 ft., left 6 in. With noise apparatus in right ear she could hear raised conversational voice in left ear.

Nystagmus: oscillation of both eyes when looking in any direction, more marked looking to the right, this was a slow movement, probably hysterical in nature; well seen in cinematograph pictures. In addition, marked by the above, there was a fine nystagmus to the left. Past pointing to the left; well seen in cinematograph pictures. Caloric tests in left ear, cold water produced nystagmus to the right and severe vertigo with nausea. When sitting or standing the head and body were flexed to the left. Rombergism: she fell heavily to the left and backwards. Doubtful dysdiadokokinesia. Inco-ordination of upper extremities well marked. Eyes shut, right hand travelled above the left when fingers were brought together, and right hand travelled the left of the middle line; well seen in cinematograph pictures.

Left arm movements inco-ordinate.

Other cranial nerves normal. Cornea sensation normal both sides.

Plantar reflexes: both sides flexor. All tendon reflexes exaggerated but equal.

The granulations in antrum disappeared under treatment.

Wassermann reaction negative.

Hysterical symptoms and Rombergism became marked, and she was admitted.

Eyes examined and found normal. No papillœdema.

Cerebro-spinal fluid, examined three times, was described as normal.

For six weeks she was kept in hospital and treated as a case of hysteria, but she became worse, and lay in bed with head flexed and body twisted to the left. It was decided to

[1] Summer Meeting held June 4 and 5, 1926.

explore the posterior fossa on the left side. The dura was opened between the lateral sinus and the labyrinth. There was at once a gush of cerebro-spinal fluid. The cerebellum did not come into view, and a spatula obviously entered a large space. Silkworm gut and iodoform gauze, used as a drain, allowed to remain *in situ* for a week. In a few days she was able to sit upright in bed, and recovered co-ordinate use of the left arm. It was weeks before she could be persuaded to stand, but in three months she walked out of hospital, and later reported herself well, and eventually took a sea voyage alone.

Cinematograph photographs taken March 24, June 27, June 30, October 29.

Case II.—Miss R., aged 38.

Abstract of notes taken May 4, 1925. Discharge and earache in both ears off and on since scarlet fever in childhood. In 1918 an operation for acute mastoiditis in the left ear in a London hospital, and in nine months from then had five operations. Slight discharge off and on since then.

Deafness always in left ear, not progressive. No paracusis. Tinnitus, ringing bells in the left ear. Severe attacks of giddiness in July, 1925, and several minor attacks daily since then, feels as if falling to the left. Has fallen down.

Right ear: tympanic membrane cicatricial.

Left ear: radical mastoid, patent Eustachian tube.

Weber left. Bone conduction good in both. Rinne right positive, left negative. Low tone limit, right 24 d. v., left 100 d. v. High tone limit, right 23,000, left 20,000. Conversational voice, right 24 ft., left 6 in. Whisper, right 24 ft., left 2 in.

No spontaneous nystagmus. No past pointing. No fistular sign.

November 17, 1925. Pain in frontal, left parietal and left occipital regions. Vertigo worse, falls to left, fallen down four times last week. Left ear dry. No nystagmus during vertigo. No past pointing. Reflexes normal. Complaining of general ill health and inability to work.

At the end of November nothing new observed, beyond possibly a slight inco-ordination of the left upper extremity and a doubtful nystagmus to the left. Admitted into hospital on December 4 for observation. Eyes normal; Wassermann negative. Cerebro-spinal fluid normal.

After being in hospital under observation for some weeks she was discharged *in statu quo*. There did not seem to be any indication as to treatment.

In February, 1926, again came under observation. Symptoms were more severe, she complained, in addition to defective eyesight, of a numb feeling in the left arm and leg.

On February 7 she had well-marked papillœdema in both eyes. General health much worse. Physical signs were as reported above. On February 12, exploration of the posterior fossa on the left side, and a condition similar to that in Case I was found. There was a large subarachnoid space in relation to the dura between the lateral sinus and the labyrinth. This region was drained in the same way as in Case I.

Patient derived immediate relief, headache disappeared, and her eyesight gradually improved. By February 27 the papillœdema disappeared, though there was some atrophy. Discharged from hospital, free of giddiness and headache, but still complaining of numbness in the left arm.

The clinical account of these cases is not as complete as I should like, but there were difficulties in investigations. The patients were bad witnesses, and hysterical. You will appreciate this difficulty when seeing the cinematograph pictures of Case I.

Both patients had chronic mastoiditis and extensive operative treatment. In both the labyrinths were intact. In both the outstanding feature was the hysterical state, and in both, behind the hysterical phenomena, there was something indicating an organic lesion. This evidence you will be able to recognize in the description of the cases and in the pictures exhibited.

The gradual general debility, hysteria, giddiness, tinnitus and headache were of long standing before the patients came under my care. In both cases the patients were in a desperate condition, and at first I felt that nothing could be done. But eventually it occurred to me that possibly there might be a basis for the symptoms in some condition in the posterior fossa, behind the chronically inflamed mastoid region. In the first case I thought of the possibility of a chronic septic process behind the labyrinth, but in the second, after the experience of the first, the possibility of subarachnoid accumulation occurred to me.

At the operation, which consisted of incision of the dura between the lateral sinuses and the labyrinth, there was no doubt of the fact that there was a considerable depth of subarachnoid space at the part where the cerebellum is usually in intimate contact with the dura, and that there was a free flow of cerebro-spinal fluid on making the opening into the space. Also without doubt there was immediate relief of the symptoms within twenty-four hours.

The object of this communication is to invite discussion on the possibility of pre-cerebellar accumulation of cerebro-spinal fluid, and the symptoms likely to be associated with such a condition.

Discussion.—Mr. LIONEL COLLEDGE said he had seen a case comparable to those narrated by the President. It was that of a girl, aged 19, on whom a radical mastoid operation had been done at another hospital in 1914. The cavity was soundly healed. She was hysterical, and had heen condemned as a hysterical patient. She complained, as did Mr. Jenkins' patients, of vertigo, tinnitus and headache, and especially pain in the back of the head. The labyrinth was intact, but she had a pointing error. After keeping her under observation for some time, he (the speaker) opened the skull through the occipital bone with a trephine. The cerebellum bulged into the wound, and on his displacing it backwards with a spatula there was a gush of cerebro-spinal fluid, the cerebellum collapsed into the wound, and the brain began to pulsate. She was immediately relieved of her symptoms. However, they returned to some extent six months later. He had hesitated to re-open the ear, for fear of introducing some septic substance into the meninges, but, apart from that, the case followed the same course as the President had described in his. In his (Mr. Colledge's) case there must have been at least two drachms of cerebro-spinal fluid locked up between the anterior part of the cerebellum and the posterior surface of the petrous. He asked whether the President had any fear that by means of drainage a fistula would be established.

Sir JAMES DUNDAS-GRANT said that Burger, of Amsterdam, published a case in which there were symptoms of cerebellar abscess, and on exposure he found no abscess, but there was a considerable escape of cerebro-spinal fluid, so that it was thought that death would occur as a result. On the next day, however, the patient was very much better. In that case it was not hysteria which was suspected, but a serious organic disease.

Mr. SYDNEY SCOTT said that the paper was an important addition to knowledge, testifying that an excess of cerebro-spinal fluid could be met with between the arachnoid and the dura mater in the cerebellar fossa. Possibly it occurred more frequently than had been suspected, one reason being that we deliberately avoided puncturing the dura mater in this region except on rare occasions.

Mr. Scott gave details of several cases in which excess of cerebro-spinal fluid had been encountered during mastoid operations unexpectedly in patients who had no suspicion of signs attributable to infective meningitis.

Dr. GRAHAM FORBES asked whether the President had had experience of similar accumulations of cerebro-spinal fluid as the result of a post-basic or cerebro-spinal meningitis, from which recovery had taken place. He had recently seen a girl whose condition suggested a cerebellar cyst. There was history of cerebro-spinal meningitis eleven years before, when she and her sister were attacked. Sister died, she recovered. When he (the speaker) saw her, she was then a fine well developed girl of 14, but she had been obliged to give up school five weeks previously because of sudden attack of giddiness with tendency to fall to the left, and headache, which persisted intermittently ever since, with occasional vomiting—temperature normal, pulse 80, arrhythmic. There was no evidence of a recurrent meningitis, but there was occipital headache; she resented being disturbed and lay curled up in bed. On examination there was nystagmus on rotation of the eyeballs upwards and to the left; no other abnormal physical signs could be found in the absence of opportunity for a complete aural and ophthalmoscopic examination at the time, but there was no history of middle-ear disease. On lumbar puncture, the cerebro-spinal fluid proved normal. He had suggested as a possible diagnosis either cerebellar tumour, abscess, or cyst. Although admission to hospital was strongly urged, nothing was done, and she died suddenly three days later. Unfortunately, post-mortem examination was refused and death was certified, on his purely tentative diagnosis, as due to cerebellar cyst. If correct, the condition, it seemed to him, might have been due to a delayed post-meningitic

accumulation of fluid, which, from the evidence they had heard, might have yielded to operation.

Mr. A. R. TWEEDIE said these conditions seemed to be associated with post-operative states and present inflammatory states, in that way differing from some of the original cases which Bárány described, which were not associated with demonstrable middle-ear disease. Bárány suggested the condition was due to a disturbance of the balance of secretion and excretion in the lateral cisterns. If that were so, the relief after operation was explained in cases in which a cerebellar tumour had been suspected but not found. This theory Bárány considered to be supported by the fact that he had noted relief in such cases due to the effects of reducing the secretion by atropine and also as the result of excessive alcohol; the latter, he submitted, might be supposed to have broken down adhesions obstructing excretion. (See *Monatsschr. f. Ohrenheilk.*, 1912, p. 781, and 1913, p. 1208.)

Mr. F. W. WATKYN-THOMAS said that he had recently seen a similar case with Dr. Andrew Wylie. A year ago the patient had undergone a right radical mastoid operation. At that time the labyrinth was dead. Two months later she had severe vertigo and headache low down in the right occipital region. When he saw her there was a dead labyrinth on the right; there was nystagmus to the left, with falling and past-pointing to the right; there was also some weakness on outward-pointing to the right, which Karlefors had found to be associated with pressure on the lateral surface of the cerebellum. A tentative diagnosis of some pre-cerebellar condition was made, and Dr. Wylie decided to explore. Before any operation was done there was a gush of serous fluid from the mastoid cavity, with complete relief of all symptoms.

He had seen another case in which Karlefors' reaction was present. A boy had an extra-dural abscess over the lateral sinus, and there was a large exposure of the posterior fossa low down. A few days after operation there was vertigo, and weakness of outward-pointing to the operated side. The symptoms were relieved by lumbar puncture. There was a slight recurrence afterwards, which completely cleared up after another puncture.

For the diagnosis of these conditions it was important to ascertain whether the pressure was in front of or behind the sinus, and this sign should be valuable.

In the two cases on which Bárány operated there was falling and past-pointing to the affected side, and in both cases an accumulation of fluid was found. In one case a labyrinth operation had been done previously.

Mr. G. J. JENKINS (President) (in reply) said that he did not think a fistula would be likely to occur in this region. He thought the condition he had described must be regarded as a partial shutting off of the subarachnoid space; it was due to a meningitis. Probably organisms were not present, but they might have been in the neighbourhood.

The Chemistry of the Cerebro-Spinal Fluid in Otitic Meningitis.

By J. G. GREENFIELD, M.D.

THE chemistry of the cerebro-spinal fluid is a comparatively new subject, as it may be said to date from the publication of Mestrezat's monograph in 1912, and it is only of recent years that it has received more widespread attention. The subject has both a theoretical and a practical side. No doubt, as practising otologists, you are chiefly concerned with the practical side, yet you will perhaps understand this better if I give you first the results of some observations which have a more theoretical bearing.

It is now generally conceded that the cerebro-spinal fluid is secreted by the choroid plexuses. And therefore if we wish to know the chemical composition of this fluid as secreted, we must examine normal fluid from as near the point of secretion as possible, i.e., from the lateral ventricles. We find this to be a saline fluid containing no cells and only 1 part in 20,000 of protein, or even less. For the moment we may disregard this, as it is possible that even this trace is not present in the fluid as it is secreted by the plexus. We may also disregard the traces of

ferments which are probably very minute, and look only at the crystalloids present in the fluid. These are the crystalloids of the blood, and their concentration in the fluid has a close relationship to their concentration in the blood. It is to this relationship and to its variations in meningitis that I wish to direct your attention to-day.

The chief constituent of the cerebro-spinal fluid is *sodium chloride*, and with one important exception (magnesium) it is the only constituent which is present in larger amount in the cerebro-spinal fluid than in the blood. Also, it is extraordinarily constant, and both under normal conditions, as well as under many conditions of disease the amount remains steadily at 700 to 750 mgm. per 100 c.c. Next comes *glucose* in very much smaller proportions, 55 to 65 mgm. Normally, in fact in practically every condition apart from meningitis, its proportion of 50 to 60 per cent. of the blood-sugar remains fairly constant. Even when the fasting blood-sugar rises to the region of 200 mgm., as in diabetes, we find this relationship holding good. *Urea* occupies a place by itself, because it is always in practically identical concentration in blood and cerebro-spinal fluid. It certainly has a smaller molecule than glucose and appears to be able to pass freely through most of the body membranes. I think that with normal low values, the urea in the cerebro-spinal fluid may be rather lower than that in the blood. This may be due to experimental error. Certainly when there is any rise in the blood-urea above 50 mgm. the urea in the cerebro-spinal fluid is found to have an identical concentration.

Then we have *acid radicles* such as *uric acid*, *phosphates* and *sulphates* in minute amounts, never normally above 2 mgm. per 100 c.c., and *bases* of which the most important are *sodium*, *calcium* and *magnesium*. The acid radicles are all (except the chlorides) present in much lower concentration in the cerebro-spinal fluid than in the blood. Of the bases *magnesium* has been found by Cohen to be present in considerably higher percentage in the cerebro-spinal fluid. The calcium in the cerebro-spinal fluid, according to Critchley and O'Flynn, probably approaches fairly closely to the diffusible calcium of the blood.

An important point to bear in mind is that with the exception of glucose and urea, which vary with the concentration of these substances in the blood, all the crystalloids of the cerebro-spinal fluid have almost constant normal values, varying at most within very narrow limits. And however much their concentration in the blood may be raised, either artificially or by disease, this has no effect on the cerebro-spinal fluid. For example, if you give a patient a heavy dose of hypertonic saline, enough to make him feel very unwell, you still find no alteration in the chloride percentage of his cerebro-spinal fluid either within a few minutes or after half an hour. Similarly, giving a normal patient sodium sulphate or sodium nitrate by the mouth does not raise the amount of sulphate or of nitrate in his cerebro-spinal fluid appreciably. This is true also for certain other drugs, such as potassium iodide, but it is not true for bromide, which appears to pass fairly readily into the fluid.

The cells of the choroid plexus therefore form a barrier between blood and cerebro-spinal fluid, a barrier which has not quite the characters of a Donnan membrane but which carries out a process of selective filtration, allowing certain substances to pass freely and keeping others back in a somewhat arbitrary fashion; a barrier, in fact, of living cells, the function of which is to prepare a fluid of a certain chemical composition from the raw material of the blood.

To the fluid thus formed very little is added from the walls either of the ventricles or of the subarachnoid space. A few cells and a small amount of coagulable protein and of ferments, such as diastase, certainly find their way into the subarachnoid space, probably along the perivascular lymphatics. When, however, there is wide-spread meningeal inflammation the barrier between blood and fluid becomes less complete and the chemical composition of the cerebro-spinal fluid approximates

to that of the blood. Magnesium falls in the fluid and approaches the percentage in the blood. The chlorides are reduced, and the other acid radicles increased. Urea and calcium remain balanced on the two sides of the membrane. Glucose behaves in an unexpected fashion, because meningitis is usually associated with a rise in the blood-glucose, whereas the glucose in the cerebro-spinal fluid tends to disappear. This may be due to the putrefactive action of bacteria, or to ferments set free in the process of disintegration of leucocytes. Thus, the disparity between the percentages of glucose in blood and in cerebro-spinal fluid becomes greater.

Now we know that the choroid plexus is damaged in many forms of meningitis, but in others it appears to remain comparatively immune. If it is damaged there will naturally be a failure in the power of selective filtration which the plexus normally exercises, but it is probable that the inflammation of the meninges also plays a part by providing a wide area where interchange between blood and cerebro-spinal fluid can take place. That at least is the hypothesis which I put forward to account for the fact that so long as the meningitis is limited to a small area, say, round the petrous temporal bone, the percentages of the inorganic salts in the fluid remain unaltered, whereas when the meningitis becomes more widespread these percentages tend to approximate to those of the blood. As I pointed out eighteen months ago at a joint meeting of this Society,[1] in which this Section took part, one may get a fluid turbid with pus-cells and containing an excess of protein and little or no sugar, but with its chemical composition, as far as the inorganic salts are concerned, remaining within normal limits. On the other hand one may have a clear fluid, with a slight coagulum and perhaps 100 cells per c.mm. with little protein excess and only a slight reduction of glucose, and yet the examination of the chlorides and the other salt radicles tells us at once that meningitis is widespread.

I need hardly add to what I said then as to the value of the examination of the chlorides in suspected meningitis. Since then I have examined several fluids which have confirmed me in the opinion I then expressed. These were turbid, purulent fluids, which suggested to the physician the possibility of meningitis, but which, on chemical examination, turned out to have a normal percentage of chlorides. In each instance the outcome of the case proved that there was no generalized meningitis.

As I said before I do not put the chemical examination of the fluid before the bacteriological or the cytological examination, but it is of far more value to estimate the chlorides and the other acid radicles, especially perhaps the phosphates, than to determine the amount of protein and glucose.

This increased meningeal permeability, or breaking down of the barrier between blood and cerebro-spinal fluid, shows itself in other ways. For example, the fibrin coagulum which is such a constant feature of meningitic fluids indicates that the fibrinogen of the blood is allowed to pass the barrier. Similarly, complement and the antibodies, present in the serum, may pass it. Again, dyes such as methylene blue and sodium fluorescein, have been shown to pass into the cerebro-spinal fluid much more readily when meningitis is present. But it seems to me that the passage of such substances into the cerebro-spinal fluid is not such a good gauge of the extent of the inflammation as the passage back to the blood of such substances as magnesium and chlorides. A small leak will allow a substance in heavy concentration in the blood to escape in traces into the cerebro-spinal fluid, but it needs a wider diffusion area to allow of the balancing of crystalloids on the two sides of a semi-permeable membrane. I think that may be one explanation why a fluid may contain much protein and a fibrin coagulum and yet show normal chlorides, but there must be another explanation, dependent on the severity of the inflammation, since both in poliomyelitis and in the acuter forms of syphilitic meningitis we may get an excess of protein with a fibrin coagulum similar to that present in acute coccal or bacillary

[1] "Discussion on the Causes, Early Recognition and Treatment of Non-tuberculous Meningitis." *Proc. Roy. Soc. Med.*, 1925, xviii (Sect. Med., Otol., Neur. and Laryng.), pp. 9, 10.

meningitis, and yet in the former the chlorides remain normal whereas in the latter they fall.

The sodium fluorescein test may be dramatic in effect, but I cannot see that it is necessary, and as it appears to be positive in most forms of meningitis, whether subacute, as for example in syphilitic meningitis, or localized, as in otitic meningitis, it is of less value than the far simpler chloride estimation.

During the last two years a number of cases of otitic meningitis have been reported in which pneumococci have been found in the cerebro-spinal fluid and yet the patient has recovered. I do not know of any such case in which a complete chemical examination of the fluid has been made, but the existence of such cases indicates that we cannot any longer base our prognosis in a case of otitic meningitis on the bacteriology of the fluid alone. We are on much safer ground if we also examine the fluid chemically, at least for the chlorides, the estimation of which is very simple. The examination of the fluid for the other inorganic salts is still in the experimental stage, but it is probable that from them also we shall be able before long to glean information of diagnostic and prognostic value.

CRYSTALLOIDS IN BLOOD AND CEREBRO-SPINAL FLUID (normal and in meningitis).

(Figures given in mgm. per 100 c.c. of fluid.)

	Blood plasma	Normal C.S.F.	Meningitis
Chlorides	560 —620 (de Wesselow)	725 —750	600—680
Glucose	100	55 — 65	0— 30
Urea	10 — 30	10 — 30	No change
Calcium (diffusible)	6 — 7 (Critchley and O'Flynn)	5·7— 6·8	No change
Magnesium	2·2— 3	3 — 3·5	2— 3
Phosphates (as inorganic P.)	2·8— 6·3 (Cohen) 2 — 4 (de Wesselow)	1·5— 2	2— 3
Sulphates	4 (Denis)	1	Above 1
Uric acid	3 mgm. (average) (Bernhard)	0·3— 1·3	1·1—4·8

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Discussion.—Mr. G. WILKINSON asked how long a time it took to estimate the chlorides in the fluid; i.e., how long was it before one could expect to get a report on the subject. Also how much fluid did the chemist want in order to carry out his investigation?

Dr. GREENFIELD replied that the examination of the fluid for chlorides occupied five minutes, and 2 c.c. of fluid sufficed for making the examination.

An Aqueduct in the Bird's Labyrinth not Previously Recorded, and its Evolutionary Significance.

By ALBERT A. GRAY, M.D. (Glasgow).

IT is not perhaps surprising that the little structure about to be described has hitherto escaped observation. It is a very short tube, very fine in calibre, and occupies a position very unexpected. It is present in the labyrinth of most species of birds, but not in all. It is not described by Retzius, nor is it mentioned by Snapp[1] in his very careful and accurate description of the blood-supply of the labyrinth in birds nor by any other investigator so far as I have been able to ascertain.

[1] *Anat. Record*, February, 1924.

The method employed to demonstrate the structure is that devised by the writer, and need not be described here.

The structure consists of a fine canal running through surrounding bone from the ampulla of the posterior canal to the recessus perilymphaticus. It leaves the ampulla of the posterior canal on the vestibular side of the crista acustica and on the lower surface of the ampulla, and opens into the recessus perilymphaticus in the superior external region of the latter cavity. The openings of the tube are funnel-shaped at both extremities. At the ampullary end it communicates with the perilymph space alone, and the same is, of course, true of the opening into the recessus perilymphaticus, which contains only perilymph. The canal therefore allows the perilymph to pass from the posterior ampulla into the recessus perilymphaticus and from there into the cranial cavity and also into the cochlea. The canal varies in length from three-fifths of a millimetre in the tinamou and common fowl to one and a fifth millimetres in the *Rhea americana*. The diameter of the tube measures about one quarter or one-fifth of a millimetre. In those birds in which pigment is found in the labyrinth, the pigment is also present in the walls of the tube, e.g., the ostrich, the cassowary, the emu, and the tinamou.

In many birds a vein accompanies the tube and permits of drainage direct from the ampullary veins to the veins of the perilymph recess and from the latter into the intracranial venous system.

This structure, for which I venture to suggest the name aqueductus ampullæ posterioris, is found in the large majority of the species of birds which I have examined: but there are a few species in which I have not been able to find it. It is present in all the ratite birds: ostrich, emu (see figs. 1, 2, pp. 45, 46), cassowary, apteryx and rhea. Besides these it is present in the red-throated diver, the penguin, the heron, the common fowl, the crowned crane, the tinamou, and some others. I have not found it in the buzzard (see fig. 3, p. 46), the crow and the thrush.

From the physiological point of view the importance of this aqueductus ampullæ posterioris is probably small, since such birds as the buzzard, the crow and the thrush, and probably some others, can dispense with it. Still, the obvious fact remains that the perilymph can pass by its means from the vestibule and semicircular into the perilymph recess and thence into the cranial cavity without passing through the cochlea. In all birds, however, the widest channel of communication is from the vestibule into the cochlea, from there into the perilymph recess, and from the latter into the cranial cavity, the aqueductus ampullæ posterioris being only a subsidiary means of communication.

But while the physiological importance of this little aqueduct may be small, it appears to the writer that it has a very interesting evolutionary significance. In order to understand this matter, however, it is necessary to recapitulate briefly the process of evolution of the aqueductus perilymphaticus and the round window, as demonstrated by the writer in a previous paper.[1]

In that paper it was shown how the perilymph finds its way from the labyrinth to the arachnoid space in the reptile, the bird and the mammal. In the reptile, except the crocodilia, a tube, termed the aqueductus perilymphaticus, opens out of the anterior surface of the vestibule curves, round the upper surface of the neck of the cochlea to the posterior surface of the latter, and there dilates into a large cavity—the perilymph recess. In this perilymph recess there are two openings. One of these is closed by a membrane and looks into the tympanic cavity, and it corresponds to the round window of the mammal. The other opening occurs in the upper medial region of the perilymph recess and opens direct into the arachnoid space. This opening corresponds to the aqueductus cochleæ of the mammal. In all reptiles, except the crocodilia, there is no opening from the cochlea into the perilymph

[1] *Proc Roy. Soc.*, B , 1908, lxxx, p 509.

recesses. In the *bird*, and the crocodilia among reptiles, the tube which leads out of the vestibule and round the neck of the cochlea has disappeared, but an opening is now found leading from the scala tympani of the cochlea direct into the adjacent perilymph recess,[1] so that the perilymph now finds its way from the cochlea into the perilymph recess and then into the arachnoid space by a very short tube in the medial superior region of the perilymph recess. The round window, closed by its membrane, is found in the wall of the perilymph recess and looks into the tympanic cavity just as in the reptile. In the monotreme mammals (*Echidna aculiata*) the arrangement is similar to that found in the bird, but the perilymph recess is rather smaller and the tube which leads from it into the arachnoid space is much longer as the result of deposition of bone round it. In the Eutherian mammals of a primitive type, such as the kangaroo, the perilymph recess no longer exists as a distinct cavity, but remains as a large funnel-shaped bulging on the floor of the scala tympani of the cochlea; and from the apex of this funnel-shaped bulging a tube leads into the arachnoid space. This tube is the aqueductus cochleæ as it is termed in the human subject. The round window is found in the wall of the funnel-shaped bulging. In most of the higher mammals the large funnel bulging in the floor of the scala tympani has become contracted in size until it is merely a rounded swelling, and coincident with this, the round window is brought in part to the wall of the scala tympani of the cochlea. Finally, in monkeys and man there is no bulging of the floor of the scala tympani at all, so that the aqueduct of the cochlea opens into the latter flush with its floor, and the round window lies entirely in the wall of the cochlea.

The question now arises: what is the relationship of the aqueductus ampullæ posterioris of birds, described in this paper, to the other structures containing perilymph? On considering the facts of the case there appears to the writer to be little doubt that this structure in the bird constitutes the vestigial remains of that tube, the aqueductus perilymphaticus, which in the reptile leads from the anterior wall of the vestibule round the upper surface of the neck of the cochlea and opens into the perilymph recess. In the process of evolution from the reptile to the bird the vestibule undergoes great diminution in size and the anterior portion of that tube disappears, causing its opening out of the vestibule to be displaced gradually further and further back. At the same time the contraction of the vestibule brings the ampulla of the posterior canal gradually forwards; and still further contraction of the vestibule brings the opening of the tube into that portion of the perilymph space which lies on the vestibular aspect of the ampulla of the posterior canal. During these changes the opening of the tube into the perilymph recess remains in position. In support of this view are the following facts. First, the perilymph tube which arises from the vestibule and encircles the upper surface of the neck of the cochlea before opening into the perilymph recess is found in reptiles only; whereas the aqueductus ampullæ posterioris is found in birds only. Second, both these tubes open into the perilymph recess in the same position in the reptile and the bird. Third, the aqueductus ampullæ posterioris is found constantly in the more archaic types of birds, that is, the birds which most nearly approximate to their reptilian ancestor: e.g., all the ratite birds, the divers, the tinamous, &c., whereas in the most recent types, e.g., buzzard, crow, thrush, &c., this aqueduct is absent. Fourth, in reptiles the pigment of the labyrinth is most abundant on the tube which encircles the neck of the cochlea and on the perilymph recess, and in the bird, when pigment is visible at all, it is found most abundant on the aqueductus ampullæ posterioris and the perilymph recess, e.g., the ostrich, the cassowary and the tinamou.

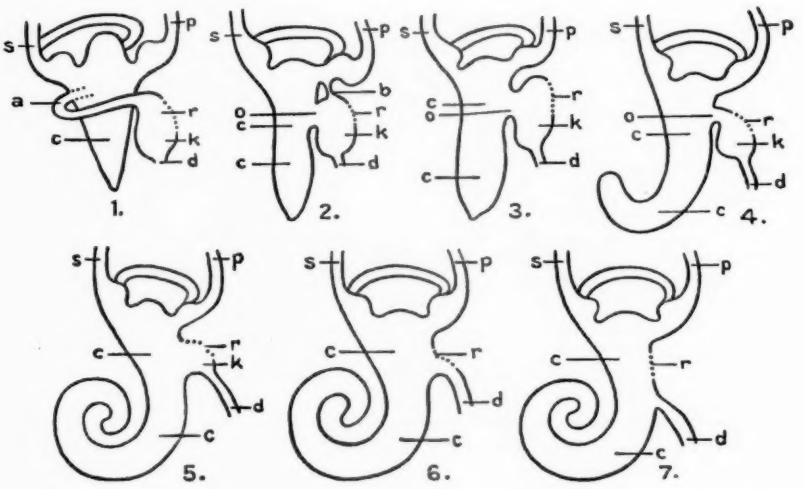
All the evidence available, therefore, leads us to the view that the little aqueduct here described to which the name aqueductus ampullæ posterioris may be given, represents in the bird that tube which, in the reptile, leads from the anterior portion of the vestibule and encircles the upper surface of the neck of the cochlea, and opens into the perilymph recess.

[1] In birds this cavity is sometimes called the recessus scalæ tympani

Discussion.—Mr. G. J. JENKINS (President) said that once again the Section had to thank Dr. Gray for a wonderful demonstration. The evidence of pigmentation was very important indeed.

Mr. J. F. O'MALLEY asked whether Dr. Gray had ever come across, in the development of the labyrinth of the higher species, such as man, the persistence of structures which were considered rudimentary in higher vertebrates as they disappeared in the course of evolution, but were normal to the lower vertebrata. One might imagine that an ill-developed labyrinth, which in man had not completely evolved, might still retain some of the features existing in the lower forms.

Dr. A. A. GRAY (in reply) said there was absorption of the bone which separated the perilymph recess from the cochlea. In reply to Mr. O'Malley, he said that he had never come across any abnormality so far, but it was possible such might be encountered; that was one of the reasons why he had read this paper. The membrane of the round window was situated at the bottom of a bony basin, and the bone projected out into the cavity of the tympanum. That projection, he thought, was a remnant of the bony walls of the perilymph recess, while the membrane had come to be flush against the wall of the cochlea. In reply to Mr. Scott, he thought the condition referred to would indicate that the bone had been absorbed more completely in the cases referred to than in the typical ones, so that the bony ring as well as the membrane itself had been brought up flush with the wall of the cochlea.



SCHEME OF THE ARRANGEMENT OF THE DUCTUS PERILYMPHATICUS, AQUEDUCTUS AMPULLÆ POSTERIORIS, &C., IN THE REPTILES, BIRDS AND MAMMALS.

1.—Reptile (except Crocodilia).—*a*, aqueduct of perilymph; *c*, cochlea; *k*, recessus perilymphaticus; *r*, round window; *d*, opening from recessus perilymphaticus into arachnoid space; *s*, superior semi-circular canal; *p*, posterior semi-circular canal.

2.—Bird of the archaic type, e.g., ostrich, tinamou, penguin, &c.—*o*, opening from scala tympani of cochlea into recessus perilymphaticus; *b*, aqueductus ampullæ posterioris. The other letters correspond with those of 1.

3.—Bird of recent type, e.g., buzzard, crow, thrush. The letters correspond with those of 2, but it will be noticed that the aqueductus ampullæ posterioris is not present.

4.—Monotreme mammal, e.g., echidna. The letters correspond with those of the previous figures. The opening *d* in the reptilian labyrinth is drawn out into the tube *d* in echidna; this tube becomes the aqueductus cochleæ of the higher mammals.

5.—Marsupial mammal, e.g., kangaroo. The letters correspond with those of the previous figures. The recessus perilymphaticus is represented by a funnel-shaped bulging on the floor of the scala tympani of the cochlea. The round window lies, not in the wall of the cochlea proper, but in the wall of this funnel-shaped bulging.

6.—Carnivorous and other mammals, except monkeys and man. The letters correspond with those of the previous figures. The deep funnel-shaped bulging of the marsupial labyrinth has become a very shallow bulging on the floor of the scala tympani of the cochlea. The round window lies partly in the wall of this bulging and partly in the wall of the cochlea itself.

7.—Monkey and man. The letters correspond with those of the previous figures. The bulging on the floor of the scala has quite disappeared so that the aqueductus cochlea opens flush with the latter, and the round window lies entirely in the wall of the cochlea.

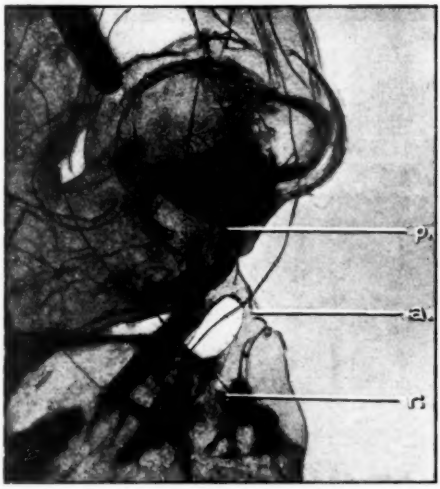


FIG. 1.

Portion of the labyrinth of the Ostrich. *p*, ampulla of posterior semicircular canal; *a*, aqueductus ampullæ superioris; *r*, recessus perilymphaticus.

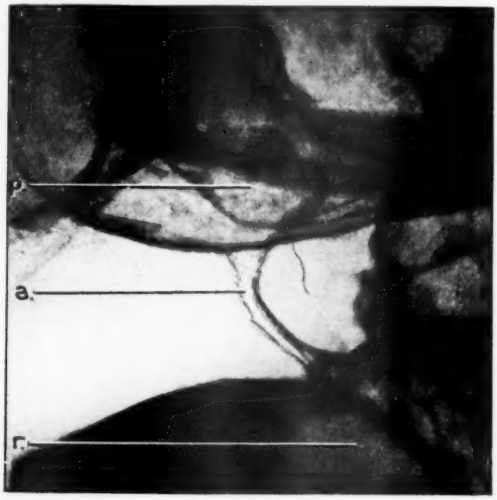


FIG. 2.

Portion of the labyrinth of the Emu. *p*, Ampulla of posterior semicircular canal; *a*, aqueductus ampullæ posterioris; *r*, recessus perilymphaticus. Note the granules of pigment in the walls of the aqueductus ampullæ posterioris.

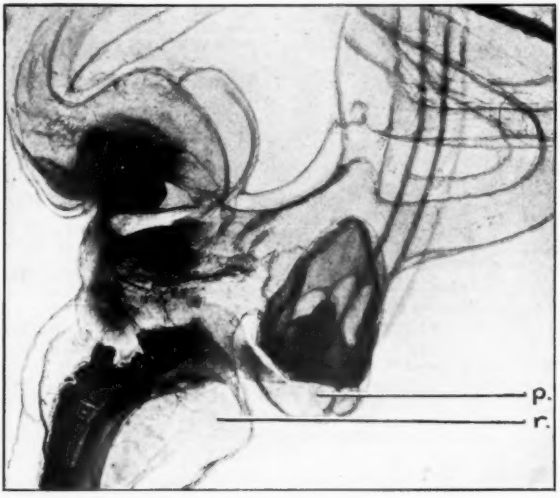


FIG. 3.

Portion of the labyrinth of the Buzzard. *p*, Ampulla of posterior canal; *r*, recessus perilymphaticus. Note that there is no aqueductus ampullæ posterioris.

Section of Otology.

President—Mr. G. J. Jenkins, O.B.E., F.R.C.S.

Case of Sudden and Complete Unilateral Nerve Deafness.

By A. R. Tweedie, F.R.C.S., and M. Vlasto, F.R.C.S.

History.—On January 25, the patient, a man aged 36, was walking downstairs, when he felt a buzzing noise in the left ear and noticed that he had become stone deaf on that side. There was no giddiness at the time of the occurrence, and his general health was, so far as he knew, excellent.

On January 27 he felt giddy on rising in the morning, but the giddiness passed off very soon. The tinnitus and the deafness persisted and are still present.

On January 28 the giddiness was more marked and was accentuated by movement of the head. It was accompanied by vomiting.

Examination.—Patient looks healthy. Wassermann negative. Blood-pressure 115 mm. Fundi and central nervous system (apart from the 8th nerve) normal.

Auditory System.—Membrana tympani normal. Eustachian tubes patent. Functional tests show a complete nerve deafness on the left side. There is no spontaneous nystagmus and no by-pointing, horizontal or vertical, nor is such induced by alterations of the position of the head.

Caloric Tests.

On February 13 no nystagmus could be induced on the left side with cold water.

On February 27 a cold caloric test (Kobrak) gave the following result :—

Applied to the right ear, 5 c.c. at 45° F. gave rotatory nystagmus to left after 25 sec., lasting 30 sec.

Applied to the left ear, 5 c.c. at 45° F. gave rotatory nystagmus to right after 40 sec., lasting 35 sec.

On March 18 a hot caloric test gave the following result :—

No reaction obtained either side with 10 c.c. water at 108° F.

With 60 c.c. water at 108° F., when applied to the right side, a rotatory nystagmus to the right appeared after 38 sec.

When applied to the left, a rotatory nystagmus to the left appeared after 25 sec.

Galvanic Tests.

Kathode right. Anode left. Rotatory nystagmus to right with 7 ma. Head inclined to left with 11 ma.

Kathode left. Anode right. Rotatory nystagmus to left with 4-5 ma. Head inclination to right with same amperage.

Rotation Tests.

Normal and symmetrical responses.

The case is shown to the Section for opinions as to the probable pathological cause of the condition.

Mr. Tweedie said whereas at first all the vestibular response had been lost, a hypersensitive condition had now supervened. With the galvanic test the nystagmus had preceded the head inclination, a reversed sequence to that normally observed.

Discussion.—Mr. J. F. O'Malley said that he had known a similar case in which deafness in one ear had followed a cold. He had found cerumen against the drum. When the wax had been removed and the ear inflated the hearing had become normal. Four months later the patient had returned with a history of influenza a week previously, and a week after

that he had suddenly once more become deaf in the left ear. There had then been complete nerve deafness. There was no history of any vestibular disturbance, but there had been some passing tinnitus. The left ear had probably permanently lost its function. He (the speaker) thought the most likely explanation of these cases was that given by Neumann, seventeen years ago, namely, that they were due to a toxic condition, the incidence of the toxin falling on the spiral ganglion, the most vulnerable point in the cochlear apparatus.

Mr. SYDNEY SCOTT said that this case reminded him of the nerve deafness associated with mumps. He (the speaker) had never seen a post-mortem examination on one of these cases, but the pathological condition had been described in a neurological journal edited by the late Dr. Alexander Bruce, "petechial hæmorrhages" being discovered "in the medulla" in the region of the auditory nerve, in a French soldier who died shortly after an attack of mumps, which had caused sudden absolute deafness.

Sir JAMES DUNDAS-GRANT said that galvanic tests were more satisfactory when not applied to both ears at the same time. Nystagmus might be induced by the tests on the good ear, and this would conflict with the evidence sought from the affected one.

Mr. G. J. JENKINS (President) said the condition in this case might be due to a toxin, but why it should select the auditory rather than the vestibular path he did not know.

A Case of Chronic Middle-ear Suppuration, Labyrinthitis and Meningitis; Operation; Recovery.

By ARTHUR CHEATLE, C.B.E., F.R.C.S.

A GIRL, aged 14, came to the hospital suffering from a chronic offensive discharge from the right ear with deep-seated pain behind and below it. Fourteen days previously she had had an attack of giddiness and vomiting with frontal headache and greatly increased deafness. Temperature, 103·6° F., pulse 120. The labyrinth was found to be dead. With the tuning-fork on any part of the head the sound was referred to the healthy ear. Rotation to the left gave no nystagmus, to the right ten seconds. There was no Rombergism or spontaneous nystagmus. Slight past-pointing to the left. The fundus was occupied by granulations. There was no mastoid œdema nor swelling. Reflexes normal. Mentally clear. Slight stiffness of the posterior neck muscles. Lumbar puncture: fluid turbid and under pressure. Cells, 100·0 per c.mm.; polymorphs, 25 per cent.; lymphocytes, 22 per cent.; ependyma cells, 3 per cent.; proteid, 0·14 per cent.; sugar, 0·0 per cent. Radical operation: cholesteatoma and granulations were found in the antrum and middle ear, and an opening in the external semicircular canal. Superior and inferior vestibulotomy were performed and an opening was made into the internal auditory meatus through the inner vestibular wall. As no flow could be established from the internal auditory meatus, the front of the cerebellum was exposed, the dura incised, and the cisterna pontis opened; turbid cerebro-spinal fluid escaped; a gauze drain was inserted, the drainage being maintained for four days. Slight facial paralysis was noticed the day after operation but it soon disappeared. The temperature gradually came down in about fourteen days. It is interesting to note how quickly the original vestibular disturbance subsided.

A Case of Acute Middle-ear Suppuration, Mastoiditis and Cerebellar Abscess; Operations; Recovery.

By ARTHUR CHEATLE, C.B.E., F.R.C.S.

A BOY, aged 18, came to the hospital with left mastoid infection following an acute inflammation of the middle ear. After the mastoid operation the temperature did not settle down and fine nystagmus to the left was noticed. Lumbar puncture: twelve leucocytes per c.mm. A week after the mastoid operation the posterior

fossa was opened and the cerebellum explored without finding pus, but the cisterna pontis was opened and clear cerebro-spinal fluid escaped under considerable tension; a gauze drain was inserted and left for forty-eight hours. The condition seemed satisfactory until twelve days after the exploratory operation, when the patient complained of frontal and occipital headache with vomiting, coarse nystagmus to the left and dysdiadokokinesis. The cerebellum was explored again and a large abscess at once opened in front of the lateral sinus; the bone was then removed from over the sinus to below and behind it, and a counter opening made into the abscess cavity which was drained with gauze in both situations. The packing was continued until it was pushed out. Recovery quickly took place. A left facial paralysis, for which no cause could be found, came on gradually during convalescence but quickly disappeared.

Six Cases of Facial Paralysis.

By Sir JAMES DUNDAS-GRANT, K.B.E., M.D.

(I) *Progressive Facial Paralysis cured by Radical Mastoid Operation.*—A boy, aged 12, first seen in December, 1925, was recommended for removal of tonsils and adenoids on account of general ill-health, wasting and lethargy; he had also a cough of two or three weeks' duration, and had had suppurative discharge from his right ear for seven or eight months. When he presented himself for removal of tonsils and adenoids his temperature was found to be raised and the operation was postponed. He returned a month later and then showed signs of partial facial paralysis on the right side, having had earache a week previously. His tonsils and adenoids were removed two days later, but his facial paralysis had become complete; he was admitted, and I performed the radical mastoid operation the next day without attempting to expose the facial nerve but carefully avoiding injury to it; I was unable to detect any hiatus. Almost immediately the paralysis diminished and in a fortnight he was discharged with the face almost normal.

(II) *Facial Paralysis with Tuberculosis of the Mastoid. Operation. Recovery from the Paralysis. Persistence of the Mastoid Disease.*—A boy, aged 14, was first seen over five years ago on account of facial paralysis accompanying chronic suppuration of the left middle ear. I obtained admission for him into the West End Hospital for Nervous Diseases and operated on the mastoid. The facial paralysis gradually subsided but the discharge continued both from the meatus and the mastoid wound, which had not healed; the tuberculous nature was verified by the microscope and various methods of treatment were applied, including several further operations on the mastoid, a sojourn by the sea, a course of general light treatment and applications of pyoktanin and iodoform. The discharge gradually subsided and the mastoid opening is getting less. The boy has grown and has no trace of facial paralysis.

(III) *Complete Post-operative Facial Paralysis entirely cured by Galvanism.*—A middle-aged commercial man with pain and slight discharge of a week's duration was found to have a nipple-shaped bulging in the postero-superior quadrant. This was nipped off with Hartmann's miniature punch-forceps and a paracentesis was also made. The discharge continued to be copious and after considerable delay I was allowed to perform the mastoid operation. There was very extensive caries and the facial nerve was, after the operation, found to be completely paralysed. The membrane rapidly healed and the hearing was quickly recovered, but the facial nerve remained inactive and Dr. MacGregor could only, with considerable difficulty, obtain a response to galvanism. However, he provided the patient with a battery and appropriate instructions. The nerve recovered entirely. The case illustrates the seriousness

of the postero-superior nipple-shaped bulging and also the hopeful attitude which should be maintained in regard to facial paralysis if skilfully treated.

(IV) *Post-operative Facial Paralysis. Persistent, but cured after Massage.*—A hospital nurse, aged about 30, developed acute suppuration in the middle ear with discharge and great pain. The simple mastoid operation was performed. The mastoid was unusually acellular, the pain continued and the facial nerve had been damaged. A more extensive and almost radical operation was carried out with complete relief to the symptoms but no improvement in the face. The case seemed destined for later nerve-anastomosis, but after a few weeks the patient showed herself with very considerable improvement, resulting in complete recovery after treatment by massage.

(V) *Facial Paralysis of six months' duration relieved by Faradism.*—A soldier, aged about 30, had had complete facial paralysis for six months and was referred to me for report on his ear. I tested by galvanism, expecting to find the usual reaction of degeneration, but with the weak current could get little or no response. I then tried mild faradism and obtained vigorous action of all the facial muscles and complete disappearance of the paralysis. I scarcely think facial paralysis could be simulated, but suppose that though the nerve had recovered the centre had remained in abeyance.

(VI) *Ante-operative Facial Paralysis not relieved by subsequent Mastoid Operation.*—Patient, a female, now aged 47, had been seen by me on account of facial paralysis and chronic suppuration of the middle-ear. An ordinary radical mastoid operation was performed and the discharge disappeared, but the facial paralysis persisted.

Twenty years later she came to me complaining of severe headache, chiefly over the left eye; she thought that the symptom might be connected with her old ear trouble. Her vision was hazy and my examination led me to diagnose glaucoma, for which I referred her to my colleague, Mr. Lindsay Rea, who confirmed my diagnosis and carried out the appropriate operative treatment with gratifying result. The facial paralysis remains unchanged.

Discussion.—Mr. BANKS-DAVIS said he knew of the case of a boy—a relative—who after a cold motor ride developed facial paralysis next day. The boy's medical adviser took him, on the speaker's advice, to a neurologist who "was against electrical treatment of any kind," and after another neurologist had been consulted the idea of electrical treatment was abandoned for reasons with which he (the speaker) could not agree, and did not appreciate. This had occurred two years previously and the boy's face was obviously still drawn up on one side—a condition which he (Mr. Banks-Davis) thought would never have arisen if the usual electrical treatment had been applied. Electrical treatment in any case maintained the tone of the paretic face muscles and kept the face straight.

Mr. SYDNEY SCOTT said that the late Dr. Lewis Jones, who had been spoken of as "the father of medical electricity," told him that in his opinion electrical treatment did no good to the facial nerve and could not hasten the recovery of facial paralysis.

Mr. G. J. JENKINS (President) said that at King's College Hospital electrical treatment was carried out not to promote recovery but to maintain the nutrition of the muscles, the view there being that it did no good to the nerve.

Sir JAMES DUNDAS-GRANT (in reply) said that in peripheral paralysis, such as in those cases now under discussion, the tendency was for wasting of muscles to occur, and there was less imminence of contraction. Too active electrical stimulation of muscles in ordinary hemiplegia was very likely to bring on contractures. In this the nuclei, by which nourishment was maintained, were not affected, but in the peripheral cases the muscles were cut off from their nucleus, hence the attempt should be made to keep up their nourishment without causing damage. Judicious galvanism was certainly beneficial, and short brushings with the *anodal* pole were, according to Dr. MacGregor, more efficacious than longer applications with the kathodal. As with the employment of digital massage and Swedish exercises, there must be discretion.

Case of Granuloma on Tympanic Membrane with Persistent Ear Discharge.

By H. J. Banks-Davis, M.B., F.R.C.P.

I am exhibiting this man—a prospective Civil Service candidate—whose candidature for the Permanent Civil Service establishment has been queried on account of a persistent aural discharge since he was serving with the Forces in Mesopotamia in 1917.

There is a red patch of granulations on the anterior surface of the membrane, appearing at first sight to be a perforation, It is, however, not a perforation, as the entire membrane moves backwards and forwards with a Siegle's speculum, and inflation of the middle ear is not accompanied by any perforation sound. The hearing is normal, and I am interested as to the nature of the condition, as I have never seen anything like it before.

Discussion.—Mr. G. J. Jenkins (President) said there were granulations on the membrane, but he could not find a perforation; he regarded the condition as superficial. An examination by culture should be made. He (Mr. Jenkins) advised a trial of 0·5 per cent. solution of copper sulphate if ordinary remedies failed.

Mr. Sydney Scott said it was curious that the condition had persisted for so long a time. It did not seem to be tuberculous; there was no destruction of drum membrane, or deafness. He (the speaker) suggested that the bacteriology should be investigated and that diagnosis should be postponed until further observation had been made.

Dr. W. S. Syme said that the condition appeared to him to be lupus.

Case of Otomycosis.

By Dan McKenzie, M.D.

Patient, a foreigner, aged 35; irritation and discharge from left ear of some months' duration.

The external meatus was slightly swollen, and on the floor close to the membrane, which was reddened, a small mass, like wet tissue-paper, was visible. Close inspection revealed a whitish mould.

Report by Dr. F. H. Teale.

Culture from the mould from ear.—The mould belongs to the *Mucor* group, and has the characters of *Mucor mucedo*. The black efflorescence is due to the sporangia. Grown on glucose agar.

Mucor corymbifer (with pear-shaped sporangia) has been described as causing inflammatory lesions in the external auditory canal, but *Mucor mucedo* seems to be uncommon.

Mr. G. J. Jenkins (President) said that as the appearance in a test-tube varied with the culturing, he did not see why it should not vary in the ear. The organism would only fructify, as the mushroom did, within a small range of temperature. The present mycelium was one of the rarer types. These organisms caused a good deal of trouble; sometimes much ulceration.

Section of Pathology.

President—Dr. J. A. Murray, F.R.S.

A Method of Isolating and Handling Individual Spores and Bacteria.

By Sydney Dickinson.

(*Dept. of Mycology, Rothamsted Experimental Station, Harpenden, Herts.*)

The difficulty in the past of isolating a single organism of microscopic size and the uncertainty of the result when the dilution method has been used, have been a great hindrance to the progress of microscopical science. Barber, in 1904, overcame these difficulties by picking up single spores in glass capillaries, while recently Chambers has used a modification of this method with conspicuous success in "micrurgy." Other methods have been attempted, such as Barnard's mercury drop method, Dunn's microloop, Edgerton's closed capillary, but none have reached the stage of everyday use, and nearly all have been but modifications of the dilution method. Hanna, however, has evolved a dry-needle method which is of great utility where large spores are concerned. The method to be described, a preliminary account of which has been published,[1] is thought to be of sufficient value and reliability, combined with ease of manipulation, to become an everyday method.

It is known that on the surface of an agar gel, when first solidified, there is a film of liquid which is a dilute solution of agar. This film, under ordinary conditions, is very thin, its depth being considerably less than the diameter of a bacterium. That this is so is evident if some half a dozen motile bacteria, lying singly in this film, are observed. They appear to be non-motile, but if a relatively large object, such as a fragment of glass, is placed gently among them, those which are in the shadow, so to speak, of the glass, immediately begin to move about in the liquid between the glass fragment, the film surface and the agar. Owing to the thinness of the film it follows that when a small number of bacteria are on an agar surface, they will lie side by side, and not superimposed one upon the other, unless agglutination has taken place. This being the case, any method by which a local thickening in the surface film can be obtained will not only allow motile bacteria to show their motility but will also provide, where the angle between the side of the thickened area and the surface film is sufficient, a means of moving motile and non-motile bacteria from place to place on the agar surface.

In the method to be described this local thickening is the cone of liquid formed between the cleanly broken end of a fine glass rod or "needle" and an agar surface, when the rod has been withdrawn slightly from the agar. This rod is mounted in balsam on the arm of a machine, to which the name "isolator" (fig. 1) has been given. This instrument, which can also be used for micro-dissection, gives a fine movement in all directions by means of three rack and pinion elements. With

[1] *Annals of Botany*, January, 1926, xl, clvii.

square stage microscopes the "isolator" is fastened to the stage, but with circular stage microscopes it is mounted on a separate stand. The needles can be made by hand by means of a micro-burner, but are also supplied by the makers of the instrument.

The actual technique is as follows. A thin layer of agar is placed on a sterile coverslip, either of glass No. 1 type or of mica, and a small amount of the material, from which it is desired to isolate a bacterium, is placed in the centre of the agar. This coverslip is then inverted over a Van Tieghem drop cell, which is fastened to a microscope slide, and this slide is placed on the stage of the microscope. Part of the wall of the Van Tieghem drop cell (preferably of vulcanite) is cut away in order that the arm of the "isolator," carrying the glass needle, may be inserted and have free access to all parts of the agar film. The essential working distance for the needle between the coverslip and the substage condenser is 2 mm. When using an oil immersion lens it is necessary to fasten the coverslip to the Van Tieghem drop cell with vaseline.

The material is focused under a low-power lens and the edge of it centred by means of a mechanical stage, while the needle is brought into position under the edge of the material by means of the "isolator." For bacteria and spores of like size mica coverslips are more suitable though not essential. A higher power lens is brought into position and focused on the edge of the material, the needle being in position just below. The needle is raised into contact with the film of liquid on the agar surface (fig. 2, *A*). When contact has been made, it is lowered slightly so as to form a cone of liquid as in fig. 2, *B*. The material is now moved up to this cone by means of the mechanical stage, and as soon as the cone is reached, some of the bacteria will be seen to float out into it. The cone is then drawn away from the material along the surface, leaving some of the bacteria in its path. While the material and the needle are still in the field of view, the needle is lowered, leaving all the bacteria on the agar. The particular bacterium which it is wished to isolate is now noted, a cone formed as before, and this bacterium is brought up to the cone and then carried in it away from its neighbours. The needle is again withdrawn, and the bacterium examined in order to make quite certain of its isolation and identity. It is quite possible with a little practice to take away one of a group of three or more bacteria, and leave the remainder untouched.

When it has been decided that the bacterium now lying alone is the one required, the cone is re-made and the bacterium is carried in it, under observation the whole time, to another part of the agar surface distant 2 mm. or more from the bacterial mass. Here again the needle is withdrawn, and the bacterium examined, and, if satisfactory, its position on the agar is marked by two scratches, one on either side of it, made in the agar by the needle, so as to be visible to the naked eye. Next, if the coverslip is made of mica, after the oil has been wiped off by a brush dipped in ether, the upper surface of the coverslip is sterilized with absolute alcohol while still on the Van Tieghem cell. It is then lifted off, and the piece of mica and agar around the isolated bacterium cut out with sterile scissors, and dropped into a test-tube containing nutrient solution. If, however, a glass coverslip is used, the agar around the bacterium, marked off by the two scratches, is cut off as a slab and transferred with a sterile scalpel to a test-tube containing nutrient agar or solution. It is interesting to note that in a series of some 500 single spore isolations made in this way only 1 per cent. of air contamination occurred, showing that the risk of contamination during the process of cutting out the agar slab and transferring it to a test-tube is negligible.

The reason why the bacterium is carried along in the cone, fig. 2, *B*, is that the direction of the applied force is nearly parallel to the plane of motion. In fig. 2, *A* the direction of this force is at an angle to the plane of motion, and the surface

FIG. 1.

Square stage type of "Isolator." (By courtesy of Messrs. Ogilvy and Co.)

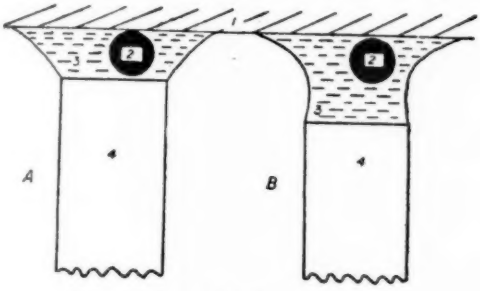


FIG. 2.

(By courtesy of the Editor, *Annals of Botany*.)

tension is then not sufficient to overcome the friction between the bacterium and the agar. In order to ensure that the needle, when withdrawn, does not carry away any of the bacteria, it is necessary that the diameter of the needle should be less than three times the diameter of the smallest bacterium in the material. If this condition is fulfilled, and the needle end, before use, is sterilized with a camel-hair brush dipped in absolute alcohol, then the needle end will be sterile, except from air contamination, throughout the operation.

It is quite possible to pick off a single bacterium from an agar film, using a rod whose diameter is four times the length of the longer axis of the bacterium, and this method of handling bacteria is quite useful, but the method preferred by the author is that of carrying the bacteria about on the agar surface.

The method was originally devised at the Phytopathological Laboratory of the Ministry of Agriculture and Fisheries, but has been modified and tested out very thoroughly at Rothamsted, where in the department of mycology it has been in constant use during the past year.

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Section of Psychiatry.

President—Dr. R. H. Cole.

Progress in Psychiatry.

PRESIDENT'S ADDRESS.

(ABRIDGED.)

By R. H. Cole, M.D., F.R.C.P.

It is a feature of recent years that psychiatry is happily becoming more closely associated with general medicine in spite of the growth of specialism.

The pathology and treatment of mental diseases are making steady progress, although it would seem that the problems presented by the relationship of law and public opinion to disordered conduct remain remarkably constant. Whilst there have been marked changes in the medical aspects of psychiatry there is a recurrence to-day of many ethical and legal questions which were raised in similar terms thirty years ago. At that time Maudsley, Blandford, Hack Tuke, Savage and Clouston, were shining lights in British psychiatry. Mercier was commencing a steady output of valuable writings, Crichton Browne was already renowned as an orator, Clifford Allbutt was joining the Lunacy Commission, now the Board of Control, and the present Lunacy Acts were coming into operation not without some travail to the psychiatrists of the day. Both psychiatry and psychology were on the eve of great developments. The French school was pushing hypnotism, and was sharply divided by Bernheim at Nancy, and Charcot in Paris. The interest in hypnotism was very wide and had far-reaching results. It acted as a stimulus to many who were confronted with mental phenomena that seemed to have little or no explanation.

Early Difficulties in the Study of Psychiatry.

Some idea of the perplexity of a young medical man who wished to engage in psychiatry in those times is worthy of record. At many hospitals no lectures were given on psychological medicine, the subject being for the most part lightly dealt with from the medico-legal standpoint by the lecturer on forensic medicine. Many students qualified without ever having seen a clinical demonstration, though some of them attempted to remedy matters by attending Bethlem or St. Luke's Hospital.

Psychology was a closed book, and was regarded as a subject for philosophers and divines, and outside the scope of medicine. As a consequence, a medical man took up an asylum appointment with a sublime ignorance of the mental maladies of the patients he was to treat, and the novel clinical material was at first confusing and disheartening. Psychology was then focused on the cognitive aspect of mental processes. The older methods of introspection had been modified by the experimental psychologists. Weber and Fechner had originated psycho-physical researches. Helmholtz had published his fine work on sensation. Wundt was still absorbed in research along experimental lines. The purely academic student still perused the writings of Mill, Spencer, Sully and others, though the classical text-book of William James soon became the standard work after its publication in 1890. Psychology almost seemed to deserve the epithets hurled at it by the energetic young psychiatrist. It did little to assist him in his special study, and seemed remote from human affairs.

Psychiatry was almost as sterile, although Maudsley, Clouston and Savage did

much to awaken it by their stimulating writings. Clinical descriptions in the text-books of the times were good, but pathology was little understood and psycho-pathology was practically non-existent. Tuke's "Dictionary" may perhaps serve as the most useful guide to the psychiatric ideas of this era.

Progress in Research on the Nervous System.

Progress in psychiatry is closely linked with progress in psychology, and with advances in many sciences besides medicine. The accumulation of knowledge that has taken place on the structure of the nervous system and its functions has been remarkable. For long it was held that if enough were known of the brain and cord, the mystery of mind would be explained. An immense amount of work continued to be done on anatomical, embryological, physiological and clinical lines to define with increasing accuracy the structure and proper functioning of the nervous system. Moreover, the knowledge of the autonomic system, its functions and relation to the later cerebro-spinal system, together with the structure and biochemistry of the endocrine glands, has grown in a manner which seems to leave little to be discovered with our present means of investigation.

Most of this work has been done in the past three decades, and a great impetus was given to the histology of the nervous system by improved methods of staining, and the development of the microscope. The scope and detail of these and allied investigations recall to memory the names of workers like Hughlings Jackson, Flechsig, Mott, Bolton, Elliot Smith, Golgi, Gaskell, Langley, Sherrington, Head, Pavlov, and many others. It may be speculation to suggest that further progress should result from the introduction of the use of ultra-violet rays in microscopy. It does seem that advance in the anatomy and physiology of the nervous system must depend upon progress in laboratory methods, and upon the results of researches which we may expect to increase the field of the microscope, and to teach us more of the properties of the living cell.

In spite of this work on the central nervous system we have much yet to learn to establish the physical basis of mind on a satisfactory foundation. Few will maintain that consciousness can exist without brain. It has become obvious that the size, quality, and structure of the brain constitute an index of the intelligence of its possessor. But we cannot yet speak of mind in terms of cerebral function, with all that we have learned of the cortex, both in health and disease.

New Psychological Conceptions.

The growth of fresh psychological views, which have thrown new light on the mechanism of insane conduct and symptoms, provide new hopes for the future.

The illuminating writings of Janet may be regarded as a landmark in the progress of psychiatry. His conceptions of dissociation, and his clear descriptions of the possible psychopathology of hysteria and psychasthenia were an inspiration to many, and merit careful study to-day. His views were taken up in America by Morton Prince and others, and paved the way for the psycho-analytic movement based upon the work of Freud. This movement has attracted followers all over the world, and has produced an immense literature. Original psycho-analytic conceptions have met with powerful opposition, some of which is reflected in the establishment of separate schools headed by Jung and Adler. There are certain features of the work of Freud which are worthy of careful notice. First, it is based upon clinical observations. Secondly, it appears to obtain biological confirmation. That is to say, it is claimed that the concept of primitive mental processes, obeying the pleasure principle, receives some support when applied to child study, fairy tales, folk lore, philology and anthropology. Further, no work has done so much to attach meaning to the apparently meaningless symptoms of insanity.

As has been indicated, psychology in earlier days was academic, and attention was centred upon the intellectual aspect of consciousness. The psycho-analytic and

other schools have moved the interest to the field of instinct. Indeed psychology has now become vitalized and brought into very close relation to psychiatry. Many workers have contributed to this desirable result. McDougall's work on instinct and social psychology has educated many beside the psychiatrist, so also has the work of Rivers. Trotter's original enunciation of the herd instinct is a splendid contribution from a surgeon, and has done a great deal to clarify the conception of conflict in psychiatry.

Psychology is making new demands, and is being applied to social as well as to medical problems. There has recently developed most instructive work on industrial psychology, initiated by C. S. Myers. His investigations into fatigue in industrialism, and the conditions which govern the output of work in factories and workshops, make fascinating reading. It seems that medical psychology has an increasing responsibility in relation to social life. Not only must we be called in to place on a scientific basis the nature of occupation, hours of work and repose, and proper recreation, but studies are necessary on such questions as the influence of alcohol and tobacco on work, the conditions which affect sleep, and the selection of careers by the young. There are yet more general questions which the psychiatrist must assist in solving. Recent controversies indicate that some modern trends in art are abnormal and have a psychopathology of their own. Changes are taking place in religious beliefs. The political world is disturbed and full of unrest. The underlying causes are psychological and the medical psychologist should be able to elucidate them. There is no end to the applications of modern psychology. Why, for example, should engineers be more susceptible to communism than miners or factory workers, as has recently been alleged?

But to us the application of the new psychology to psychiatry is of chief importance. What has it done? What is it going to do in the future? The answers may be summarized in three words, psychopathology, psychotherapy and prevention.

Psychopathology has been given a re-incarnation. It is evident that many of the novel concepts concerning the mechanism of mind are finding a permanent place in the literature of psychiatry. Terms like conflict, repression, projection, sublimation, transference and libido are familiar to all, and provide us with fresh implements for research and treatment. The causation of the psychoses has been placed in a new light, and for the first time in the history of psychiatry a scientific explanation of the bizarre conduct of the psychotic patient is available. The future holds great things in store for psychopathology, and the scope for psychopathological research to be found in our mental hospitals is obvious. The chronic type of patient has much to inform us as to the source and development of delusions and hallucinations.

Psychotherapy has advanced far in recent times. Its practice is capturing the attention of the general physician more and more and its place in medicine is assured. Psycho-analysis is one method of several approaches to psychotherapy, but it is yet early to speak with conviction concerning the results of analysis. The method seems of little use in the established psychoses. No army of analysts could successfully return to normal life the chronic patients living sheltered lives in the institutions of our country. As to early cases, and psychoneurotics, there seems to be little information available to determine whether psycho-analysis obtains better results than older methods of treatment. Discussion concerning the nature and functions of the unconscious mind continues. Different schools have their own methods of treatment and investigation, and seem to diverge along paths whose end is not yet in sight. Some writers there are who have done great service in co-ordinating the somewhat confusing views and teachings of clinical psychologists. Both psychopathology and psychotherapy in this country owe a debt to Bernard Hart, whose incisive style presents to the medical profession a well defined picture of the psychology of insanity and its application to methods of treatment.

Prevention of disease, which is one of the chief aims of medicine, will, as regards mental disorders, be augmented by the lessons of the new psychology. The after-care of patients discharged from mental hospitals is receiving close attention. Thirty years ago the investigation of child psychology was in its infancy. Among other developments the organized tests for intelligence have reached a high standard. The last fifteen years have seen great progress in the investigation, care and treatment of defectives of all grades, though more remains to be done. The teaching that the foundation of neuroses or psychoses can be laid in the first few years of a child's existence is one which requires earnest consideration. The ignorance of the public concerning mental hygiene is still a serious matter, and the spread of education in such knowledge is of the utmost importance to the coming generation.

General Paralysis.

The study of general paralysis best illustrates the progress that has been made in brain pathology. It is hard to realize that the pathology of general paralysis has remained so chaotic until these latter days. The disease was mostly attributed to sexual and alcoholic excesses. Some authorities described the paralytic diathesis and maintained that paretics were "born, not made." Clouston at one time even used to say that paresis was a certificate of general intelligence. Yet the specific origin of the disease was suspected as far back as 1857. The elucidation of the pathology of general paralysis may be regarded as the greatest step that has been made in cerebral pathology in our generation, for not only has the establishment of the spirochæte as the cause of paresis definitely cleared up an old problem, but the work has opened up many new questions. As is almost the rule in scientific progress, the answer to one query raises a host of others. Why should paresis only occur in a small percentage of syphilitics? What is the meaning of the long latent period between infection and the onset of symptoms? Is another factor beside the spirochæte necessary to produce the clinical entity we know as general paralysis? Or is there a special strain of the organism responsible for the disease? It is not yet definitely known, indeed, how the organism invades the brain, nor why the application of arsenical compounds is so disappointing when applied to nervous syphilis. One cannot leave this absorbing chapter in mental pathology without mentioning the outstanding work of Sir Frederick Mott. He has taught the specific origin of paresis with a persistence and insight that was fully justified by the demonstration of the organism in the brain of a sufferer, by Noguchi in 1911. We have gained increasing assistance in the diagnosis of the forms of syphilis of the nervous system during the last twenty-five years. Wassermann has given us a test, which, if properly carried out, enables the presence of syphilis to be determined with certainty. The new knowledge of the composition of the cerebro-spinal fluid, and its behaviour in the presence of various infections, has been of inestimable value. General paralysis was always regarded as a hopeless disease, although it appears that energetic treatment by mercury and the more recent arsenical compounds has invariably influenced the course of the disorder. Of late years the malarial treatment has introduced new hope for the victim of paresis. Men are now living comparatively normal lives who were so treated a few years ago. It seems definitely established that the method applied to suitable patients gives the best chance of improvement or even recovery that medicine has yet been able to offer. Looking back over thirty and more years and recalling the uncertain pathology of the disease, its subjects for the most part untreated until the inevitable end in institutions all over the world, there is no more dramatic instance of progressive triumphs in psychiatry in which clinicians and laboratory workers have happily shared.

Progress in Clinical Conceptions.

Noteworthy progress has been made in the improvement of our clinical conceptions; older views have been attacked, new and sound entities established.

Of all those writers who have taken part in the advances of clinical psychiatry, Kraepelin, of Munich, has, perhaps, claims to the premier position. He has given us the conception of the manic-depressive psychosis, and has defined the conditions now grouped under the term dementia præcox. His writings are models of close observation and description. Not only do we owe to him new clinical ideas, but he has done much to produce our existing system of classification. Moreover, he has re-educated us in the importance of the longitudinal section in psychiatry, by his insistence on the careful study of the life history of mental cases.

Clinical conceptions are returning once more to a state of fluidity. Increasing difficulty is being experienced in placing a patient in any definite category. The puerperium, the climacterium and the senium, are being dethroned as specific factors in producing insanity. More satisfactory ætiological foundations are being formed for confusional states. One of the chief difficulties of clinical description is the diversity of meanings attached to the same terms when used in different countries. An early standardization of our nomenclature is desirable, and would mark a step forward in the psychiatric progress of the world.

PROGRESS IN THE CARE AND TREATMENT OF THE INSANE.

Both care and treatment of patients have received unremitting attention, and it may be that in some respects care has outstripped progress in treatment. As regards institutions for private patients, in many of them not only have fabric and equipment been brought up to date, but the treatment aspect is paramount and the element of detention is receding, as is illustrated by the increase of voluntary admissions. Up to the time of the 1890 Act and even afterwards, there was great activity in building rate-supported institutions, some of which reached an immense size. Of later years there has been a return to smaller hospitals, and this is desirable on many grounds.

Many improvements in the administration of mental hospitals have taken place. All of us have gladly seen the last of the old term "Pauper Lunatic Asylum." Rate-aided patients are better clothed, and their dresses and suits are less like uniforms than they were. Provision for occupation, both in- and out-of-doors is more generous, and work is often rewarded with some local currency with which patients may make simple purchases in a shop or store provided for the purpose. Contact with the outer world is maintained more completely, by newspapers, wireless, and an increasing system of leave and parole. Cases are separated into categories as far as that is possible, and few institutions are now without a reception ward or wards for each sex, even if a separate building is not available for the recent cases. Another necessary change for the better in the care aspect of our patients has been the improvement in the dietary scales.

Coincident with the growth of the hospital idea we find the slowly developing practice of employing female nurses for male patients. This has had excellent results, but is still in a somewhat experimental stage, and the good male nurse will never entirely disappear. The progress in the standard of nursing in mental hospitals can best be described as amazing. The Royal Medico-Psychological Association must be given much of the credit for this work. The syllabus of training and examinations for the proficiency certificate in mental nursing was commenced thirty-five years ago. General as well as special training is being insisted upon, and the formation of a State Register on which mental nurses may be included is a step in the right direction. Occupation therapy has been developing lately, and, it is hoped, will become more general. It is true that patients have been employed in workshops, laundries, and farms, where they have been largely engaged in work, often of a lowly nature. But occupational therapy is meant to inform, to re-create and re-educate. Pioneer work of this kind is now being carried out in this country and the system should take its place in the equipment of all our large hospitals.

Progress in treatment must ultimately result from research and advances that are made in other branches of science. The whole of the past thirty-five years has been marked by a slow but increasing equipment in laboratories, and devoted laboratory workers. In this, psychiatry owes a debt to the London County Council, who established the central laboratory at Claybury, thirty-five years ago, now moved to Denmark Hill. Whilst London may rightly be considered the centre of psychiatric research, much activity has been shown by workers scattered throughout Britain. The labours of Bevan Lewis at Wakefield, the patient investigations of Ford Robertson in Scotland, and the stimulating centre at Cardiff under the energetic direction of Edwin Goodall, deserve special mention. It is to be hoped that these examples may be followed by Birmingham and other places. Some of the older methods of therapy have gone. The heroic treatment of excitement by the administration of croton oil or the cold shower was an occasional practice in early days. The development of the continuous bath has done much to solve the problem that acute excitement presented to psychiatrists, though there is nothing new in hydrotherapy. The application of endocrine extracts has proved disappointing, though it is pregnant with possibilities, and increased knowledge may show us more effective and accurate methods of applying endocrine principles. The value of bed treatment for acute cases has been fully established and the same may be said of the open air methods which are now almost universally practised and approved. The padded room is disappearing, together with the various appliances for mechanical restraint. The nightly dose of hyoscine is becoming a thing of the past, and the use of sedative drugs has been limited and improved, and is better understood.

To-day we find the subject of treatment approached from two widely different angles. Two schools are striving for the ascendency. The psychological school labours to prove the worth of psychotherapy, in which school psycho-analysis makes the widest claims. The other view-point is taken up by what may be called the toxic school, searching for hidden sources of infection, and in their turn making large claims, and producing results which cannot be ignored. It is gratifying to find that the work of Sir Almroth Wright and other pioneers of vaccine therapy is slowly but surely extending to psychiatry with hopeful results. The contest between the psychogenic and physiogenic schools might well end in a happy division of the territory they dispute, and an admission that much of the clinical field should be held in common. As infections may be causes in the production of mental disorders so also psychological factors may lower the resistance of the individual to bodily disease.

Recent advances in medicine are imposing a call for increasing knowledge and skill in the younger generation of psychiatrists. The wide gap which existed between the psychiatrist and the general physician has been rapidly lessened. Studies in basal metabolism, blood-sugar reactions, the tests of renal, hepatic, and pancreatic functions have important bearings on the future progress of treatment in psychiatry. New fields are opened up by the cutaneous protein tests, and the procedure of desensitization, where individual idiosyncrasies to proteins are found to exist. Fertile ground awaits the tiller, and it is open to us to reap an abundant harvest. While the labourers are still all too few, the enthusiasm of the younger workers should enable them to meet the demands that are likely to be made upon them.

The Teaching of Psychiatry.

It becomes increasingly clear that the teaching of psychiatry and psychology is of immense importance if we are to maintain the progress that the science is making. The medical practitioner still commences his professional life with a scanty knowledge of the mind in health and disease, a state of affairs which requires amendment.

It is, however, a pleasant task to recall the advancement that has been made in the status and education of those medical men who enter the service of our mental hospitals nowadays. Reference has already been made to the bewilderment and confusion that overwhelmed the young doctor who formerly entered psychiatric practice. An assistant medical officer used to be largely engaged in work of a dispiriting kind. Changes in many directions have been made by the steady pressure of enlightened opinion. Pay and promotion are much more adequate, pensions funds are established, and marriage is possible for several members of the staff of a large hospital. Original research is encouraged. Study leave is granted, and the possession of a diploma or degree in psychological medicine will no doubt become compulsory for those who seek promotion to higher appointments.

The teaching of psychiatry in medical schools is making decided progress. The University of London has always held out a helping hand to medical psychology. Originally, it required every candidate for the higher degrees in medicine and surgery to pass an examination in logic and psychology. This continued until some years ago when a paper on mental physiology was substituted for the previous hybrid. This paper was only discontinued, some think unwisely, when psychological medicine was relegated as one of the special subjects for the M.D. degree. Lately the diploma for proficiency in mental disorders or mental deficiency has been established by London as well as most other Universities, and by the Royal Colleges. Years ago many students rarely came into contact with mental cases. Now, every school has a lecturer on psychiatry, who is usually on the staff of the hospital and has an out-patient department which the student can attend. There he gains some insight into early cases, psychoneurotics and defectives, many of whom find their way to the department for treatment and teaching purposes. In addition, he must attend at least eight clinical demonstrations at a recognized mental hospital. Many consider this tuition to be insufficient, but in view of the crowded state of the medical curriculum we are told that it is all that can at present be reasonably expected. Speaking generally, it may be said that students are much interested in medical psychology, and when qualified they are now much better able to deal with the mental cases they may meet, than were their predecessors. The general public shows an increasing interest in psychology, and the subject should, if possible, become a more prominent feature of medical education.

The Clinic.

Much has been written and spoken concerning the establishment of clinics for the treatment of mental disorder, by which it is hoped to supplant the existing mental hospitals, or at any rate to provide accessories to what has been called "custodial care and treatment." This need has no doubt arisen largely owing to the failure of existing legislation. It is unfortunately true that for no less than 87 per cent. of patients who are certified there has never been any opportunity for voluntary residential treatment. The development of clinics for the care of both in- and out-patients without legal procedure will do much to speed up early treatment in psychiatry. A parallel movement is the desire of many to obtain powers to allow voluntary patients to enter rate-aided institutions. Both proposals deserve whole-hearted support. The clinics will help to bring our speciality into closer touch with general medicine, and existing mental hospitals will increase their hospital character and lose the invariable element of detention which so diminishes their prestige and value.

The opening of the Maudsley Hospital on the lines of the suggested clinic marks a fresh era in psychiatry in this country, and is a fitting memorial to one of our greatest teachers. The contemplated move of the Bethlem Royal Hospital is a matter for regret to many of us who owe so much to that premier teaching hospital.

Bethlem has for years been a shining example of the hospital principle in psychiatry. The large proportion of voluntary patients received there speaks for itself. There is no reason why many institutions should not reproduce the fine work done by Bethlem, were suitable changes in the law obtained.

A Plea.

Recovery-rates are often said to be low in psychiatry as compared with other branches of medicine. The last return of the Board of Control shows a recovery-rate of 34·8 per cent., and discharge-rate of 53·5 per cent. of the direct admissions of certified patients. Recent inquiries concerning the fate of 1,000 consecutive admissions to an American mental hospital show that 26 per cent. recovered and remained well, while a further 14 per cent. improved sufficiently to return to their homes. Such figures would no doubt compare favourably with the same number of patients admitted to a general hospital.

An afternoon spent in the out-patient department of a large general hospital reveals a high incidence of chronic disease. The future of those patients admitted to mental hospitals, who do not proceed to recovery requires consideration. The view that is tacitly, if not expressly, formulated by many who are keenly interested in the welfare of early treatment, that the unfortunates termed "chronic" should be segregated in separated buildings, anywhere and anyhow, with the minimum of medical care, would, it is feared, entail a return to the inhuman methods of the past. In registered hospitals and licensed houses it is found that the presence of voluntary patients has a beneficial effect on many of those who are detained on a judicial order. Experience teaches that it is rare to find most recent cases, voluntary or otherwise, to be adversely affected by mixing with selected certified fellow patients. Moreover, many of us have been deceived by an appearance of chronicity in a patient who has ultimately made a good recovery, and, therefore, a plea should be recorded for the case that we term chronic.

Psychiatry and the Law.

A recent and hopeful sign of progress that ought not to be overlooked is the requirement of a knowledge of psychiatry by all doctors seeking appointments to the prison medical service. The detection of insanity in prisoners under remand, or when first sentenced, is often a matter of difficulty. A tribute is due to the prison medical officers for the advances they have made in the diagnosis of mental disorder or defect among the prisoners under their charge.

Criminology is making considerable advance, and many important changes have taken place in prison methods during this generation. Reference will only be made to one relevant topic which concerns us as psychiatrists—the criminal responsibility of the insane.

The professions of law and medicine are still unable to see eye to eye on this important subject. The legal mind appears to be bound by tradition and still clings to the McNaughton rules, which our own profession for the most part considers antiquated and unjust. Defect of reason should not be the sole and governing factor in establishing irresponsibility for crime. The recent Atkin report does not satisfy us, for the continuance of these rules hampers the medical witness in his replies, and frequently prevents him from making his evidence consonant with his convictions. It would almost seem as if our legal administrators were distrustful of medical evidence relating to matters in which criminal responsibility is involved, even when given by highly qualified authorities. The legal profession appears to fear that the doctrine of psychological determinism might absolve a person from the consequences of his actions. This is an entirely mistaken notion. The tenets of medical men and psychologists do not differ from those of their fellow citizens in regard to the necessity of punitive measures for crime. Only when mental disease amounting to insanity exists, is it thought justifiable that the penalties for breaches of the law

should be modified. It may be said that such is also the view of the lawyers, but the methods by which the criterion of insanity is to be established in criminal cases do not meet with our approval, and are not abreast of modern knowledge.

Other differences we have with our brethren of the law. Legal change is slow, and we are undoubtedly hindered in our work by existing legislation. Admission to a mental hospital still involves cumbersome legal machinery, which should be simplified. We have welcomed the appointment of the Royal Commission, and it is to be hoped that real progress may result from its labours.

Psychiatry and the Public.

If the relationship of psychiatry to law reflects a lack of progress, what can be said of the public attitude to our branch of medicine? It is disappointing, to use a mild expression, to find a recent leading article in a highly respectable daily journal, referring to the devoted men who have laboured for psychiatry in the past as "keepers of madhouses." Such an expression, applied to the memories of a Maudsley or a Mercier, can only reflect a deplorable ignorance on the part of educated public opinion.

A novel has lately appeared, written by a distinguished author, and dealing with the adventures of an elderly psychotic who is finally admitted to a mental hospital. The terms in which the descriptions are written are disquieting and reminiscent of the past. Prejudice and unfamiliarity with existing conditions indicate the want of sympathy and understanding shown by a section of the general public to the psychiatric physician and his work.

Yet both articles and novels, hostile though they be in some respects, are portents of a growing public concern for the welfare of the insane. This interest is undoubtedly the main contribution that the Great War has given to psychiatry. The neuroses of war added little to the knowledge of the psychiatrist. It may be that something was learnt of the influence of fatigue, exhaustion, and stress upon the mental health of large bodies of men. Something too, was learnt of the diffuse lesions produced in the nervous system by the effects of severe concussion. But to the public, the appearance in their homes of large numbers of mentally afflicted soldiers was a new thing. The success in treating these war cases has been largely due to the fact that treatment was early, even immediate, and was often dramatic in its results. The deaf were made to hear, the blind to see and the palsied to walk. Public interest was roused, and has spread to those members of the community who suffer from mental disorder necessitating hospital care. How are they housed and fed? Why are they not cured? Why is their liberty curtailed? What has happened to the doctors? Such are the questions that are being asked, and the public is eager for information.

The first step should be to insist on the fact that insanity is no peculiar horror, no strange plague that strikes down without reason or warning. From the "shell-shocked" soldier to the maniac of popular imagination there is but a difference of degree. Both suffer from mental disorder, and for both there is good hope of amelioration and cure. Destructive criticism is easy, but of little value in shaping the future. We want public co-operation, financial aid for research, generous contributions to the funds of mental institutions, and above all the trust that has been happily given to medical men in every other branch of practice.

The study and practice of mental disorders is the most difficult and sombre in the whole domain of medicine, but recent knowledge has shed a ray of sunshine and the future is bright with hope. Let our interest direct our work, be it at the bedside or in the laboratory, and the continued progress in psychiatry will be assured.

Section of Psychiatry.

President—Dr. R. H. Cole.

The Problem of the Mongol.

By R. M. Stewart, M.D.

It has recently been said that knowledge advances much more slowly than the writing of papers, and this is particularly true of the subject I propose to discuss to-night, for, although a vast array of papers has been devoted to the study of the mongolian idiot, there is little in the work of the last three decades to justify a confident pronouncement on its ætiology.

At the onset I must confess that I have no observations of a novel or striking character to put before you, but the problem of the mongol is one of those questions, supported by contradictory theories, which may be expected to enliven and stimulate productive discussion. Moreover, the disease is one the incidence of which appears to be increasing, and I feel, therefore, that it may be of some interest to members of this Section to review as briefly as possible the various hypotheses which have been advanced to explain its origin.

The Clinical Features of Mongolian Idiocy.

Before discussing the ætiology of mongolism it will be convenient to call to mind its chief clinical features. The first and most striking feature of the mongol is his resemblance to others of the same type. So closely do they resemble each other that it is difficult to believe they are not all members of one family, and to see and examine one is sufficient to obtain an adequate conception of the characteristics of the type.

The features have a fairly close resemblance to those of the racial Mongol. The cranium is invariably small, free from bossing or eminences, and usually presents a flattening of the occiput; to a lesser extent this flattening is evident in the face. With few exceptions the mongols are bradycephalic, and in some cases the antero-posterior and transverse diameters of the skull are almost equal; the cephalic index is therefore high, varying between 80 and 85.

The long axes of the palpebral fissures are oblique and slope downwards and inwards. In infancy there is usually a marked development of the epicanthic fold, but, according to Crookshank [1], this is less characteristic than the obliquely-placed fold of loose skin situated just above the upper lid and most marked at its inner angle. In childhood the eyelids are thin and frequently become affected by various inflammatory conditions, with consequent shedding of the lashes.

The eyes are often small, and may be either rather deeply set or unduly prominent. The colour of the iris varies, although blue-eyed mongols appear to predominate in this country. When blue it often shows a curious speckled arrangement of the pigment, to which Langdon Down first drew attention. Ptosis, nystagmus, and eye-rolling are common, and, according to Brushfield [2], strabismus is present in some degree in every case.

The bones of the face have a tendency to flatness, the prominences and hollows being less evident than in the normal child. The face is sometimes described as moon-shaped, and the prominent cheek-bones so characteristic of the racial Mongol are almost never seen. The nose is generally short, squat, with a markedly depressed bridge which recalls that of the congenital syphilitic child. The nostrils look forward

as well as downwards, and are often narrowed or triangular in shape. Nasal catarrh is common. The superior maxilla appears under-developed, the naso-pharyngeal cavity small and shallow, and the palate high and narrow. Speech is usually guttural and indistinct; in some cases it is never acquired. The lower jaw is more rounded and more prominent laterally than in the normal child, and may be prognathous. The teeth are late in making their appearance, irregular, and prone to early decay.

The ears are generally small, rounded, simply convoluted, and, in a typical case, shell-like in outline. The upper part of the pinna is prominent, and the lobule may be defective.

The tongue often protrudes from the mouth and may be abnormally large, although its protrusion more often depends on the smallness of the oral cavity. It is said to be normal at birth, but by the third or fourth year of life it has acquired numerous transverse fissures, which become even more marked in succeeding years. This fissured, or scrotal, tongue, as the French term it, may be regarded as one of the most characteristic signs of mongolism, but it is an error to assume that it is found in no other type of ament. In the course of the last three years I have seen four typical examples in mental defectives who showed no other signs even remotely suggestive of mongolism (see fig. p. 13). Curiously enough, three of these patients were the victims of congenital syphilis. Occasionally fissuring of the lips is also seen, and the lower lip not uncommonly protrudes.

The cheeks of those who reach childhood are rosy and plump, the skin of other parts of the body being coarse and covered in certain situations with a growth of downy hair. On the scalp the hair is coarse, wiry and sparse. The eyebrows resemble those of the racial mongol in being unduly arched, and they may be sparse, as in the myxœdematous subject.

The mucous membranes are peculiarly liable to chronic catarrh and adenoids are very frequent.

In infancy the hands are remarkably soft, the digits thick and clumsy looking, the thumb and little finger short; the latter is often abnormally curved towards the mesial line, and X-ray examination usually shows that the second phalanx is shorter than the third. The palms show various departures from the normal arrangement of lines and are sometimes remarkable for the number of lines running in all directions.

The feet are likewise short, broad, clumsy, with fallen arches and an unusually long second toe. There is also frequently a large cleft between it and the hallux and an imaginary line connecting the tip of the toes is almost at right angles to the axis of the foot: webbing of the fingers or toes is not an uncommon finding. In some cases the sole presents a well-defined line running towards the heel from the first interdigital cleft.

Congenital and other forms of heart disease are often encountered in hospital mongols, and evidence of defective circulation is seen in their cold, blue extremities.

In stature the mongol is usually stunted with a straight spine, a relatively narrow long trunk and short limbs. Knock-knee is often present.

The abdomen resembles that of the cretin in being enlarged so that it protrudes beyond the level of the chest when the mongol is recumbent. Herniæ, usually umbilical, but sometimes inguinal, are very generally present.

Owing to a laxity of the ligaments there is an unusual mobility of the joints, especially those of the digits, wrists, ankles and hips.

When seated, the young mongolian imbecile usually disposes his lower limbs in the horizontal plane, in other words, he "sits cross-legged like a Turk."

The mental characteristics of the mongol show a certain parallelism with the physical, and although all degrees of mental defect may be found, the majority tend to remain imbeciles or idiots and show little or no response to training. As a rule

they are lively, imitative, and often have a love of music which is rather striking. In disposition they are good-tempered and, as Sutherland remarks, the "smiling face of the mongolian imbecile suggests the possession of a secret source of joy." Lastly, they appear to have an almost complete immunity from epilepsy.

I would like here to make a passing reference to the adult mongol. My notes have been compiled from an examination of twenty cases in the Leavesden Mental Hospital, their ages varying from 16 to 43 years.

The adult mongol preserves most of the featural characteristics seen in childhood. The growth of the cranium is much retarded and I have only encountered one case in which the circumference exceeded 21½ in. Clinical observation also shows that the mongol remains stunted in growth, the mean height of twenty cases in my series was 56 in., the smallest measured 49 in. in height, and the tallest 60 in.

In fourteen the palpebral fissures were narrow and oblique; in the remaining six practically normal. In twelve, blepharitis and partial loss of eyelashes were noted, but epicanthus, which is so noticeable in the juvenile mongol, was present in only three patients, and even in these was so slight as to be easily overlooked. Three presented strabismus and three nystagmus.

Fissured tongue in congenital syphilis.

Marked fissuring of the tongue was noted in fifteen cases, in three it was slight, and in two it was entirely absent.

In none of my cases was excessive mobility of the joints a noticeable feature and only three patients assumed spontaneously the "cross-legged tailor" attitude.

Umbilical hernia, which is nearly always present in mongolian infants, could only be found in three patients.

With regard to the state of development of the external genital organs it was found that the penis was small and infantile in three cases, the testicles rudimentary in seven, while in one cryptorchidism existed. The pubic hair was of the female or semi-feminine type in eleven cases.

With a view to determining whether the formed elements of the blood of the mongol show any constant departure from the normal, such as is seen in diseases of the ductless glands, I made total and differential leucocyte counts in twenty-eight adolescent and adult mongols (Table I). No abnormalities in the shape, size, nuclei

or staining properties of the white cells could be found, but in exactly one half of the series the percentage of small lymphocytes exceeded the physiological limits, in one case being as much as 49 per cent. When present, this lymphocytosis was, however, considerably lower than the average percentage found in the blood of patients suffering from different types of ductless gland disease.

TABLE I.—TOTAL AND DIFFERENTIAL LEUCOCYTE COUNT IN MONGOLISM.

No.	Age	Red blood corpuscles	Hæmoglobin	Leucocytes	Polymorphs	Eosinophils	Small lymphocytes	Large lymphocytes	Basophils
	Years	Per c.mm.	Per cent.	Per c.mm.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	24	3,720,000	90	11,250	59·6	8·1	27·5	4·3	0·5
2	24	5,140,000	90	10,800	60·2	2	35·8	2	0
3	22	4,900,000	90	8,600	63·6	4·3	29	2·5	0·5
4	23	6,850,000	100	7,500	64·6	1·4	25·6	7·8	0·6
5	23	4,560,000	90	8,600	65·2	0·8	29·8	4	0·2
6	22	6,390,000	90	10,300	67·2	3·4	19·4	10	0
7	21	5,100,000	—	6,800	64·6	1·8	31·3	2·1	0
8	21	5,080,000	80	11,000	46·4	0.8	49	3	0·8
9	21	5,780,000	90	9,100	60·2	4·8	29·2	5·2	0·6
10	21	5,420,000	100	12,200	50·8	1·4	45	2	0 8
11	28	5,160,000	100	10,900	51·6	2	39·8	6·4	0·2
12	24	4,930,000	100	8,000	52·8	3	39	4·8	0·4
13	21	5,600,000	90	8,200	73	3·6	20·2	2·8	0·4
14	27	5,600,000	90	8,400	45·4	1·4	46·2	7	0
15	42	6,030,000	90	9,000	47·8	1·2	34·6	16·2	0·2
16	19	5,070,000	90	7,600	67·4	3·2	22·8	6·6	0
17	23	5,750,000	100	10,000	55	2·6	36·4	5·4	0·6
18	19	5,500,000	90	9,500	46·4	2·6	46	4·6	0·4
19	28	6,530,000	90	11,400	59·2	3	32·4	5·4	0
20	22	5,200,000	100	10,000	57·2	8·8	29·8	4·6	0·6
21	16	5,060,000	80	10,500	50·2	5	43	1·8	0
22	27	4,950,000	90	6,300	84·2	1·8	6·4	7·6	0
23	23	4,960,000	90	11,200	68	2·4	26·2	3·4	0
24	24	4,080,000	100	11,100	61·2	11·2	23·4	3·4	0·8
25	20	4,800,000	90	11,400	49·2	3·8	38	9	0·8
26	19	5,460,000	100	8,200	70·6	0·8	24·4	4	0·2
27	33	4,020,000	100	8,400	47·8	1·4	45·6	4·8	0·4
28	22	5,920,000	100	8,500	70·2	2·6	19·2	8	0

TABLE II.—BLOOD-PRESSURE IN MONGOLISM.

(Tycos Sphygmomanometer. Auscultatory Method. Patient recumbent).

No.	Age	Systolic blood-pressure	Diastolic blood-pressure
1	29	108	50
2	23	86	54
3	17	90	50
4	17	90	40
5	25	86	58
6	29	90	62
7	28	96	64
8	28	84	52
9	33	84	50
10	18	124	62
11	22	84	60
12	20	98	66
13	23	92	64
14	20	100	68
15	25	115	70
16	34	108	62
17	24	78	46
18	34	90	58
19	43	96	64
20	18	78	40

In conclusion, a word may be said regarding the circulatory system. In a series of forty-two mongols, blueness and coldness of the extremities were present in thirty-eight, but valvular disease of the heart appeared uncommon, only four cases showing definite physical signs. One interesting feature in the course of my study of the mongol's circulation was the low pulse tension of many patients, and, on taking

accurate readings with the sphygmomanometer, I found that with four exceptions the whole series exhibited a marked degree of hypotension (Table II, p. 14). In more than half, the systolic blood-pressure did not exceed 90 mm., and in three patients it was below 80 mm. It would be interesting to know whether hypotension is as constant in other forms of mental deficiency.

So far as the adult is concerned, it would appear that Nature does her best to improve the unfinished mongol, and that with the advance of years not a few of the characteristics tend to disappear.

The Pathology of Mongolism.

What at once strikes the observer on looking through the literature devoted to this subject is the scanty and diverse nature of the majority of pathological reports, and I do not know of a single instance in which the nervous system has been examined in a really exhaustive manner.

With regard to the osseous system, the cranium, orbits and wings of the sphenoid bone are thin and the base of the skull notably shortened. The maxillary sinuses are small and the nasal bones dwarfed or even absent.

The brains of mongols seem to differ considerably, but are nearly always smaller and lighter than normal. The convolutions are simple and somewhat large. Evidence of some degree of arrested development may usually be found. In one brain I examined the insula was partly exposed owing to an imperfect development of its operculum.

Smallness and under-development of the cerebellum and brain-stem have been described in the majority of brains examined, and may be correlated with the shortened base of the skull. In addition to smallness of the cerebellum, Gans [3] noted the presence of a heterotopic mass of grey matter on the median side of the flocculus.

The condition of the ductless glands is not well known, and in most reports they have been described as normal.

No pathological changes peculiar to mongolism have been discovered in the nervous system, and there is a notable absence of the pigmentary deposits which are so characteristic a feature of the cretin's brain. The pia-arachnoid may be thickened in places and adherent to the subjacent convolutions, but changes of a definite inflammatory character have seldom been reported.

The pyramidal cells of the cerebral cortex are said to show immaturity and numerical deficiency; the nerve fibres show an attenuation of their myelin sheaths. Some writers lay stress on the paucity of tangential fibres. No important changes have been noted in the blood-vessels or neuroglial elements.

The only contribution I am able to make to the histopathology of this disease is to draw attention to the comparative frequency with which binucleated Purkinje cells may be seen in the cerebellar cortex. Their presence in the brain of the mongol is of some interest, for they occur in even greater frequency in the cerebellum of congenital syphilitic aments.

The Ætiology of Mongolian Idiocy.

Mongolian idiocy is essentially a congenital condition which can be recognized at an early stage of intra-uterine life, and it is therefore only necessary to consider inherited causes which may affect the parental germ plasm preceding conception of the mongol, and, secondly, the different factors which may adversely influence development of the embryo or fœtus *in utero*. With regard to the inherited factors, while neuropathic inheritance may, and probably does, play a part in the genesis of other forms of feeble-mindedness, in mongolism it appears to be an almost negligible factor, for in this disease the family histories are usually singularly free from those affections which are regarded as evidence of a bad stock. In my series a history of insanity, epilepsy or mental deficiency was only noted in two out of eighteen families investigated. Still more striking is the fact that it is quite exceptional to find more than one mentally defective child in a mongol's family. Thus, Swanberg and Haynes [4],

who investigated the family history of a mongol twin, were unable to find a single case of feeble-mindedness in nearly 200 known blood-relations, representing five generations for the paternal side and four for the maternal.

Much has been written on the effects of alcohol and tuberculosis in the parents as an ætiological factor, but the testimony of numerous observers makes it almost certain that these agents have no causal relationship to mongolism. Nor do mental stresses in the mother appear to have any special significance, for inquiry usually shows that the shocks or frights have been sustained late in pregnancy, long after the fœtus has been formed. In the absence of reliable evidence to show that the health of the mother is the important factor, certain writers have been led to cast suspicion on the father. Thus, Dr. Dora Berry [5], while noting that mongolian children are in many cases the offspring of young healthy mothers, finds considerable evidence to support the view that preceding conception the fathers may be "sexually defunct." In two-thirds of the cases studied the fathers had served in the late war, and of these nearly half gave a history of shell shock. On these grounds she suggests that the mongols are engendered through the agency of defective germ-cells in the fathers.

Another possible factor which has excited a good deal of discussion is the age of the parents at the time of conception. In many instances the mongol is the last member of a large family, the mother being consequently near the close of the reproductive period of life. Out of twenty-four unselected cases I found that in fifteen, or 62 per cent., the mothers' ages exceeded 40 at the time of conception, and in a series of ninety-six cases Brushfield found the mothers' ages to be 39 or over in 66 per cent. On the other hand the ages of twenty-six of the mothers in Dr. Berry's series of fifty cases were between 21 and 35 years at the time of the child's birth, and one-half of the children were the first or second members of the families. This difference between the ages of mothers of asylum and hospital mongols is striking, and suggests that the widely accepted theory of reproductive exhaustion in the mother has been based on the study of too small a series of mongols. Moreover, the fact that the "exhausted" mother may have several normal children subsequent to the birth of a mongol, or may give birth to twins, one normal and one a mongol, clearly indicates that uterine exhaustion can have no special significance.

In spite of the fact that mongolism does not run in families certain authorities hold the view that it is a definite unit character, inherited as a Mendelian recessive. Herrman [6], who subscribes to this view, calls attention to the frequent association of mongolian idiocy with other congenital anomalies which are said to be inheritable according to Mendelian principles. "Is it possible," he asks, "that the association of these anomalies with mongolian idiocy in the same individual is not merely a coincidence, but that the peculiarities of the brain, skull, and face are dependent on similar causes and inheritable according to Mendelian principles?"

The weak point in Herrman's argument seems to me to lie in his ready acceptance of the principles of Mendelism, coupled with his admission that in the human race accurate and complete pedigrees, which might be used to substantiate the Mendelian theory, can hardly ever be obtained.

The Anthropological Theory.

In a paper published in 1886, Langdon Down [7] suggested a classification of idiots by their ethnic characters, and gave the first detailed description of the mongolian idiot. On the basis of the featural resemblance of the mongolian idiot to the racial Mongol, subsequent writers have evolved an atavistic hypothesis to explain its origin, and this theory has lately been brought into prominence by Crookshank [1]. In his view we have a very fair explanation of most of the medical facts concerning the parentage of mongol children if we consider occidental mongolism as a unit character in the Mendelian sense.

It is difficult, if not impossible, to present a fair summary of the arguments advanced by Crookshank in support of his thesis, or to review the evidence he presents in favour of homologues between the mongolian idiot and the orang, nor is it possible within the limits of a short paper to refer to the anthropological data he presents. I shall therefore content myself by noting one difficulty which suggests itself to me.

According to Crookshank the term mongolism should not be reserved for those who are mentally defective, because many children of normal intelligence and many parents of mongolian idiots have mongoloid features and peculiarities. For Crookshank, it is the mongolism rather than the idiocy which it is important to stress. For my own part I am inclined to believe that the physical peculiarities are inseparably bound up with the mental defect and that any theory of mongolism must recognize this mental defect as one of the cardinal features of the disease. That this is so is, in my opinion, shown by the fact that among racial mongols there may be found mentally defective children showing the additional characteristics for which we are accustomed to look in the European mongolian imbecile. In other words the physiognomy of the mongolian imbecile is so distinctive that it cannot be masked even when it is found in the racial Mongol. Moreover, the fact that within the last twelve months several observers have recorded cases of mongolism in members of the negro race, would appear to constitute a fatal objection to his theory of atavistic orangism.

The Endocrine Theory.

As already stated there is a certain degree of resemblance between the mongol and the cretin, and in view of the fact that the growth of the body, and even the development of the nervous system, are to a large extent controlled by the endocrine organs, it will be of some interest to note the evidence which has been brought forward in support of the ductless-gland theory of mongolism.

On the pathological side there is very little to be found. No cases showing a marked atrophy of the *thyroid gland* are on record, but microscopic lesions of an inflammatory or sclerotic character have been noted by Bernheim-Karrer [8], Kassowitz [9], Unger [10], Oberthur [11], Raeder [12] and others. It is highly probable that the changes recorded by these observers were in all cases accidental or secondary. In the one case in which I have had the opportunity of making a post-mortem examination the thyroid showed little alteration.

Attempts have also been made to implicate the *pituitary body*. Timme [13], for example, noted an alteration of the pituitary fossa in X-ray photographs of the cranium and inferred the presence of foreign tissue interfering with the function of this gland. His observations have not been corroborated nor have any noteworthy changes been discovered in either lobe of the pituitary.

Abnormalities in the *sex glands* have also been described and I have myself observed the absence of interstitial cells in the testes, but such changes are common in all diseases associated with arrest of sexual development.

The striking success which attends the exhibition of thyroid substance in cretinism is never seen when mongols are similarly treated, nor has treatment with any other glandular product the slightest influence on the disease.

Lastly, the basal metabolism of the mongol is well within the limits of the normal, and, consequently, if any degree of hypofunction in the thyroid is present it must be too slight to have any special significance in the causation of this disease.

Relation to Syphilis.

In appraising the value of any theory which is held to explain the origin of this disease, it is necessary to bear in mind that certain clinical conditions must be satisfied. First, although a history may be forthcoming of a severe physical or mental shock to the mother during pregnancy, a mongol may be born of a woman

who was in apparently good health at the time of conception and during the whole period of pregnancy. Secondly, both parents may be at the zenith of their reproductive period of life, being neither unduly young nor unduly old. Thirdly, the mongol may not only be the first- or last-born child, but may occupy an intermediate position in the family. Fourthly, pregnancies terminating in the birth of normal children may both precede and follow the birth of a mongol; and lastly, the mongol may be one of twins, the other being a perfectly healthy child. Let us see how far the syphilitic theory fulfils these conditions.

It is well known that syphilis shows an extraordinary capriciousness in its effects on the pregnant female and her offspring. The disease may be entirely latent during pregnancy and the first evidence of maternal infection may be an abortion or the birth of a diseased or deformed child. Whilst histories of abortions and still-births are common in the families of all forms of mental deficiency, I am inclined to believe that they are unduly frequent in families containing mongols, and I have been struck by the frequency with which the birth of a mongol is foreshadowed by one or more miscarriages.

In my notes on twenty-three cases, one or more miscarriages before the birth of the mongol occurred in fifteen instances, and in one the cause could only have been syphilis. In this case the mother stated that her health had always been excellent. During the first years of married life she had six miscarriages—"small affairs"—followed by the birth of a succession of premature children. One was born dead at six and a half months; a second, at seven months; a third, at seven and a half months, lived for one hour; a fourth, at eight months, lived three days; a fifth, at seven months, lived several hours. The sixth child survived, and is now nineteen years old, delicate, with a "tendency to consumption." The seventh child, a breech presentation, showed the features of mongolism, while the eighth and last child died at birth. At the time of birth of the mongol the mother was in her fortieth year. A rough examination of her nervous system showed irregular eccentric pupils, reacting sluggishly to light, and absent knee-jerks. Her blood Wassermann reaction was strongly positive; that of the mongol was negative.

It is also a familiar observation that there are numerous exceptions to the general rule which states that the degree of transmissibility of syphilis usually diminishes in proportion to the duration of the disease. Whilst first pregnancies in infected women are usually likely to end in early abortions, followed in succession by late abortions, infected children and finally healthy offspring, it not infrequently happens that a syphilitic child is, as it were, slipped in between healthy children, much in the same way as the mongol may occupy a place in the family between normal offspring.

Lastly, there is the extraordinary fact that a syphilitic woman may give birth to twins, one of whom presents numerous stigmata of congenital syphilis, whilst the other is apparently free from infection.

It is, I think, obvious from the foregoing remarks that while general conditions, such as worry or exhaustion of the reproductive function, cannot afford a satisfactory explanation of the causation of mongolism, there is no inherent difficulty in accepting the view that a syphilitic infection of the parent might be responsible, and if it be conceded that syphilis is the principal ætiological factor its *modus operandi* must be one or other of the following:—

(1) When present in the parent or even grandparent, the syphilitic virus causes some alteration in the germ cell.

(2) Syphilitic infection of the developing embryo leads to pathological changes which are ultimately expressed in the mental and physical peculiarities of mongolism.

Now there appear to be good grounds for supposing that syphilis in the parents may lead to infantilism in the offspring unaccompanied by any of the obtrusive signs of syphilis, and Hutinel [14] has brought forward a considerable amount of evidence in support of his contention that endocrine disorders due to syphilis in one

generation may lead to dystrophies in the next without any necessary transmission of the syphilitic virus. If this be so, may not mongolism be explained on similar lines? In other words, may not mongolian idiocy be a parasyphilitic disease, in the sense that the cerebral agenesis is the outcome of nutritional changes originally initiated by a syphilitic infection of the parents? An answer to this question ought to be forthcoming by the application of the Wassermann reaction, but, unfortunately, the number of parents submitted to this test is too small to permit of any reliable conclusion being drawn.

If evidence in favour of the second alternative—a syphilitic infection of the embryo—be forthcoming, it will be legitimate to expect the mongol to show, in at least some cases, certain of the common manifestations of congenital syphilis. That these changes are conspicuous by their absence no one will be prepared to deny. It is true that certain writers, notably those in France, have described mongols presenting Hutchinsonian teeth and other frank manifestations of congenital syphilis, but I am inclined to believe that the majority of such cases may be simply mis-diagnosed examples of the latter disease, for at times there is a real danger of confusing the two conditions. Van der Bogert [15], for example, has recorded an extremely instructive illustration of this difficulty. Of a family of four children, the eldest was a typical mongol, with a positive Wassermann reaction in the blood. There had been no miscarriages and no history of syphilis could be obtained from the parents, but four years after the birth of the mongol, twins were born, one of whom (when examined at the age of 5 years) was a normal child with a negative Wassermann reaction. The other was a congenital syphilitic, bearing so close a resemblance to a mongol that, when shown at a clinical meeting, he was accepted by all present as an example of this disease.

Babonneix and Villette [16] have also recorded four mongolian idiots in one family. The father suffered from leucoplakia of the mouth, and the mother had two miscarriages and six still-births. There were good reasons for suspecting a syphilitic infection of the parents. It must be admitted, however, that records of this character are extremely rare, and to estimate, in the right perspective, the relationship of syphilis to mongolism it is necessary to make an extended survey of the literature.

The possibility of syphilis being an important factor in the ætiology of mongolism, either before or after the conception of the child, appears to have been first mooted by Sutherland [17], who found in a total of twenty-five cases definite evidence of parental syphilis in eleven instances, and its probability in three. The majority of subsequent investigators have failed to note anything approaching this high incidence, and the introduction of the Wassermann reaction has shown that a positive reaction in either the mother or child is quite an exception.

In a series of twenty-six cases analysed by Muir [18], evidence of syphilis was obtained in only three families, and Still [19] could only find a single instance of parental syphilis in a fairly large series.

Zubizaretta [20] thought syphilis a factor in 12 per cent. of a series of twenty-two mongols, while Shuttleworth [21] reported evidence of syphilis in but four out of 350 cases.

A wide disparity in results has also followed the introduction of the Wassermann reaction. In 1913, Gordon [22] noted the presence of a negative Wassermann reaction in eight mongols, and in the same year Holt [23] recorded negative reactions in a similar number.

In a study of the relationship of congenital syphilis to endocrine disorders, Vaglio [24] noted the presence of a positive Wassermann reaction in the blood of a mongol and both its parents once; positive in the mother and negative in the mongol once; and negative in both mongol and parents twice. In the same year, Stevens [25] obtained a positive reaction in 21 per cent. in a series of thirty-eight mongols, and in a second series of eighteen mongols studied at a later date, 33 per cent. were positive.

In 1916, Di Giorgio [26], in a series of sixteen cases, obtained a positive reaction in the father twice, in the mother twice, and in both parents once.

In 1917, Herrman [27], working on similar lines, reported negative reactions in the mothers of six mongols. In the same year McClelland and Ruh [28] examined both the blood and the cerebro-spinal fluid of thirteen mongols, and reported entirely negative results. They concluded that the findings reported by Stevens were due to error in technique. Comby [29] noted that in his series of sixty-nine cases, syphilis could only be admitted as an ætiological factor in two or three cases; whilst on the other hand, Pentagna [30], in a paper published in 1920, found conclusive evidence of syphilis in fifteen out of forty-one cases, whilst in eleven others it was probable. An equally high incidence was found by Pollet [31], who concludes that the relationship of syphilis and mongolian idiocy is an intimate one, and not merely accidental. He claims to have found the co-existence of congenital syphilis and mongolism in 57 per cent. of cases, and its probable relationship in 29 per cent.

In 1923 Lind [32] reported from Australia one positive Wassermann reaction in six mongols examined and in the same year I published with Dr. Riddel [33] the results of an examination of the blood and cerebro-spinal fluid of fifty-five cases.

The Wassermann reaction was uniformly negative in the cerebro-spinal fluid, and only one mongol gave a positive reaction in the blood. Since this date, however, two other cases with positive reactions in the blood have come under my care. We also employed the colloidal gold reaction, and in every fluid examined we obtained precipitations in the lower dilutions corresponding to the type of curve described by Eskuchin under the term "lues latens." In all cases the cell-count and globulin-content were within the limits of the normal.

Carrière (quoted by Dop) [34], in a survey of sixty-five mongols seen in private and hospital practice, found conclusive evidence of syphilis in the father and mother twelve and four times respectively, a probable syphilitic infection in the father six times, and in the mother twelve times. The application of the Wassermann reaction to thirty parents gave six positive results in both partners, three positives in the father, and six positives in the mother. In nine instances there was evidence of syphilis transmitted through two generations.

Out of forty mongols submitted to serological tests seven gave a positive Wassermann reaction and twelve a positive Hoecht reaction. Similar tests applied to the cerebro-spinal fluid gave ten positive Wassermann and twelve Hoecht reactions.

Lastly, in 1924, Dr. Berry [5], in the paper referred to above, reports the Wassermann reaction negative in the blood of the mongol and its mother in all the fifty cases examined.

Viewed from the standpoint of the Wassermann reaction, it is evident that the statistical evidence for the proper evaluation of syphilis in the ætiology of mongolism is most conflicting, and certainly in this country the majority of Wassermann reports affords no secure basis for the syphilitic theory.

None the less, in a recent publication Dop [34] boldly asserts that congenital syphilis is the determining cause of mongolian idiocy, and that in some cases it may be due to the transmission of syphilis through two generations. The cerebral agenesis he regards as secondary to an inflammatory affection of the meninges localized at the base, and involving the pituitary body. In short, all the characteristics of the mongol are explicable on the basis of a derangement of the neuro-glandular mechanism.

It must be noted, however, that Dop attributes to syphilis an amazing number of diseases, ranging from the vast majority of infantile encephalopathies to numerous endocrine diseases, and for this reason his conclusions must be accepted with the utmost reserve.

The pathological evidence in favour of the syphilitic theory is slight. Mild degrees of meningeal thickening and adhesion are so common in all varieties of

mental deficiency that little importance can be attached to their presence in the mongol's brain, except that in one extremely interesting case Babonneix [35] discovered a small meningeal gumma occupying the sulcus separating the right pre-frontal and post-frontal gyri. So far as I am aware this is the only case in which an unmistakable syphilitic lesion has been recorded, and its presence in this case may possibly have been entirely fortuitous.

A word may be said as to the peculiar property of the mongol's cerebro-spinal fluid to precipitate colloidal gold in the syphilitic zone. This phenomenon, which was first reported by Stevens, and at a later date confirmed by Riddel and myself, is of great interest, but it cannot be used as an argument in favour of a syphilitic origin for this disease, for the so-called paretic and syphilitic curves may be found in a variety of non-syphilitic diseases such as disseminated sclerosis, poliomyelitis, lethargic encephalitis and diphtheria; furthermore, until the rationale of the test is more completely understood, arguments based on its behaviour are clearly inadmissible.

At this stage it would perhaps be wisest to conclude by saying that while syphilis cannot be considered an exclusive cause of mongolism, it may yet possibly be an indirect factor in its production.

Theory of Amniotic Pressure.

Finally, there is the view expressed by Van der Scheer and Jansen [36] that all the symptoms of mongolian idiocy find a ready explanation on the assumption that during the sixth and seventh weeks of development the amnion lags behind in growth, and by raising the amniotic pressure compresses the still flexible fœtus and so arrests development of the brain. Jansen also considers that the same nocive agent, operating at other and earlier stages of development, may cause anencephaly and achondroplasia.

Conclusion.

In conclusion it may be said that up to the present none of the theories concerning the origin of mongolian idiocy can be held to assimilate completely all aspects of the problem. There is admittedly much to be learnt, for we are still on the threshold of that knowledge which we hope ultimately to possess, and until the pathology of the disease has been fully worked out the ætiology of mongolism is likely to remain obscure.

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Discussion.—Dr. Langdon Down said that Members present must all feel indebted to Dr. Stewart for the clear and complete way in which he had summarized what was so far known about this disease and the problems bearing on it. He thought it could be said that, in the

main, there was no great disagreement as to the ordinary clinical features observed. Dr. Stewart had now added one to those generally mentioned, with which he (the speaker) agreed, namely, the straightness of the spine. Dr. Crookshank, in his book, stressed certain things about which there would be a difference of view. For instance, he spoke of the non-wrinkling of the forehead; but it was only necessary to look at the photographs which Dr. Stewart had exhibited on the screen to be satisfied as to the marked wrinkling. The same authority also spoke of high malar prominences, and those, he (the speaker) agreed with Dr. Stewart, were rather noticeably absent.

He was tempted to take the broader view of the problem. It was a very interesting one, spreading into the realms of biology and anthropology, as well as constituting a problem in clinical medicine. How far was this disease dependent on the original composition of the ovum; on the materials of which the ovum was made up, in other words, on what it inherited? How far did it depend on what happened to the ovum in its development?

He would choose two or three leading and agreed statements which would put that question to a rough-and-ready test. As Dr. Stewart had said, this was an extraordinarily well defined group. He was aware that there were certain individual cases of mental defect in regard to which there might be a difference of opinion as to whether they presented mongol traits, but, on the whole, the group was one of the most readily recognized known. In it, practically all the structures of the body were involved; epiblast, hypoblast, and mesoblast, all were affected and altered by this condition. There was a very striking difference, in the mongol children of a family, from the other members of it, and yet there was a striking resemblance to children of the same type in other families. If the individual children were the result of an accidental combining of the genes from two parents in a bi-parental race, it was difficult to believe that this could happen as a mere chance combination of genes in one family. Another fact which had to be taken into view was the occurrence of these children either at the beginning or the end of a large family. Dr. Stewart's figures did not raise the expectation of that occurrence to a very high pitch, but even he would agree that there was a difference in respect to these children with regard to their position in the family. How was that to be explained if it was a mere chance aggregation of the genes? There was something which ordered the occurrence. Therefore, these children, like every organism, were partly the result of their hereditary make-up and partly of their surroundings. And it did not follow that because one could not attribute the mongolism merely to a hereditary basis there was nothing in the heredity which was necessary in order that it should occur. There might be some factors necessary in the genes in order that, when environment came to play upon them, the condition should arise. If the environment was responsible, he would refer to another fact, which could be seen in the clinical picture, demonstrating, he thought, that the mongolism must originate at the earliest possible moment, before any of the structures were really laid down. As an instance of this, he referred to the transverse line of the hand; that was present in a number of these children, but not in other defectives, and it was an essential part of the structure, which must be laid down from the very first. There were numerous other aspects of the matter which led one to say that, whatever was the cause, it must have been in operation extremely early in the development of the ovum. What these influences were he believed was quite uncertain. From his own experience he was not disposed to agree that syphilis was always the cause; it was rarely so, in his view, if at all, though it might be concurrent.

Was it possible, therefore, to regard the condition as a reversion? Mechanically, what would a reversion be under these circumstances? It would be that, in an ovum, in which there were certain possibilities of development in a certain direction, something had occurred quite early in the development which directed it into an unusual, perhaps an abandoned, channel, and left it there. What that poison was he could not say, but he thought it was some cause other than syphilis affecting the mother. Reversion to another type might take place, because there might be a reversion to an imbecile who was a true representative of the modern Chinaman, which he agreed that the mongolian was not; he had certain characteristics which had been compared to those of the primitive Chinaman, but were not like those of the modern Chinaman whom we knew. He knew an imbecile who could readily be mistaken for a real, living, modern Chinaman, and that would be a reversion at a different stage, and less far back.

Dr. F. C. SHRUBSALL said that Dr. Stewart's account of the adult mongol had been particularly interesting; this type was less often met with than the familiar juvenile form. He (Dr. Shrubsall) could add nothing to this description, but he had collected a few data

bearing on the ætiology of mongolism. The mongol was often the last child in a large family, but sometimes he occurred earlier. In really large families however it was the exception for one of the earlier children to be affected; when an early child was affected the family was usually small. Out of 310 cases recorded under the Mental Deficiency Act in London, in two instances the mongol was the last of sixteen children. The parents, even when the mongol was an only child, were usually elderly, many of the mothers being well over forty years of age. He had noted that in nearly a third of the instances the father was younger than the mother, a point to which attention did not seem to have been directed. The social class of the parents of mongols was above the average, the middle classes, skilled artisans, clerical classes, the army, navy and police being represented in undue proportions among the cases investigated in London. It appeared also to be a type represented in the upper classes also. As regards the family history: out of 310 cases, thirty-four showed a family history of insanity, twelve of mental deficiency, and thirty-three of other neuropathic conditions. In seventy-eight there was a history of tuberculosis, which was not a high proportion. In none of the cases was there an admitted history of syphilis. Many of those kept under supervision had died chiefly during the later school age and in early adolescence. The chief causes of death were respiratory disorders and the infectious fevers of childhood. Contrary to expectation few had been certified as dying from congenital heart disease.

Any theory of the origin of mongolism had to explain not only the usual stigmata but such affections as polar cataracts, which occurred in unusual frequency in this class of defectives. If Dr. Crookshank's theory of the origin of the condition from racial Mongol strains were correct mongolian imbeciles might be expected to occur more often along a line stretching in from Hampshire and Dorset to Oxfordshire, along the courses of the Essex and East Anglian rivers and in Aberdeenshire; areas in which some 2,500 years ago there had been an invasion of stocks,—the Prospector and Beaker folk,—that might have shown some mongolian traits. Certainly it seemed as if there were more mongols in the south and more cretins in the north, though this might be due to geological rather than to racial causes. The statement that Dr. Crookshank's theory must be wrong because of the occurrence of mongol imbeciles among negro races was not necessarily correct, for the Bushmen, who presented a few facial traits similar to racial mongols, were formerly widespread in Africa and might supply the element that Dr. Crookshank postulated. He (Dr. Shrubsall) could see no ground for associating mongols with orangs except that the endocrine or other factors which led to the development of the face might show a similar contrast between, say, the negro and the mongol on the one hand and the chimpanzee and the orang on the other. In certain cases the parents of a mongol imbecile had shown some traits of mongolian character. Jansen's theory seemed attractive, and if there were reasons for supposing chemical preventives had been used in certain instances in which there was a long gap between the birth of the mongol and of the last of the previous children, it might well be that these had served to check the growth of the amniotic membrane.

Dr. W. A. POTTS (Birmingham) said that Dr. Stewart's most interesting account of the mongolian condition was the best he had ever heard or seen. The pictures which had been cast on the screen had in every case demonstrated what they were intended to show.

He understood Dr. Stewart to say, when discussing the ætiology, that the neuropathic factor was absent. With that he (the speaker) agreed if he meant a definite history of insanity or other well-marked condition; this was absent as a rule. He would not agree, however, that there was no neuropathic factor present, because, in nearly every case, the mother had been neurotic, and, frequently, the father as well; it would not be right to speak of those parents as normal people. He did not accept the idea that syphilis was more than an occasional factor. He could look back upon instances of women whom he had attended in their confinement, and whom he knew to have had syphilis, yet not in any of those cases was the child a mongolian. Conversely, in cases in which he had seen mongolian children born he could be practically certain there was no syphilis. Most of these cases, in his experience, occurred at the end of a long family, and at a time of life when the husband was not at all likely to have an active syphilitic infection, and there was no other feature in the family history indicating that disease. He had not heard it suggested before, but if one were to look for an unfavourable factor which was frequently present in pregnancy and which might sometimes determine the birth of a mongol child, the most likely one seemed to be intestinal toxæmia, as that was the most frequent abnormality in the antenatal clinic of a maternity hospital. He had frequently seen marked cases of colitis, whilst

appendicitis was not uncommon. In nearly every case there was constipation, in most of them it was severe. There was apparently toxæmia which dated from early pregnancy, and it was conceivable that in some cases this might exercise an unfavourable influence on the developing embryo. Extreme constipation was more frequently present than syphilis; at the ordinary antenatal clinic one did not see many cases of syphilis, though in every case about which there was suspicion the Wassermann test was carried out.

He could not help thinking that if Sir Frederick Mott had been present at this meeting he might have said that Dr. Stewart had substantiated his thesis that poorly-developed genital organs constituted the essential cause in many of these cases. Possibly mongolism might be associated with some failure of the adrenal secretion; possibly the mother's intestinal toxæmia prevented her receiving an adequate supply of adrenal secretion in the early days of pregnancy, when the fœtus had no adrenal secretion of its own. Many believed that the birth of a mongol in a family, where such an event seemed possible, could be prevented—though this could not be proved—by administering thyroid to the mother during her pregnancy, with ovarian extract, primarily to combat the deficiency of thyroid secretion and the defective action of the mother's ovaries.

Dr. PHILIP CLOAKE said he had recently read abstracts[1] of some work dealing with the occurrence of mongolism in twins. The writers of these articles had succeeded in getting the facts concerning a number of twins both of whom were mongols, and in those cases the twins were always of the same sex. When mongolism was present in only one member of twins, the healthy twin might be of either sex. From this it was argued that twins who were both mongols were uni-ovular twins, and that the essential cause of mongolism must lie in the germ-plasm, and could not be an environmental factor. If that work was sound, it was a strong point in favour of the view.

Dr. R. H. COLE (President) said that the Section were indebted to Dr. Stewart, whose paper had led to a productive discussion; also to Dr. Shrubsall for his careful statistics. He would like to hear what Dr. Stewart meant when he spoke of diagnosing mongolism during intra-uterine life. Dr. Potts's remarks included a reference to the prevention of mongolism, but to the speaker the difficulty seemed to be that of knowing when a mongol child was likely to arrive. In the course of his official duties he had to see many mongol children. A young married couple—the husband, aged 25, the wife, aged 23—had a mongol child now 2 years old, and the parents asked him recently whether they were justified in risking having another child. It was a very difficult matter on which to give an authoritative answer, but his personal view was that such children were comparatively rare—and he looked upon them from the atavistic point of view—that Nature was not likely to repeat the defect in the same family. With regard to the epicanthic fold, it had been an interesting question to him as to why it arose. In syphilitic children one found a tendency to an epicanthic fold, and he regarded it as due to the want of the bridge of the nose. So also, as mongols progressed in years the nasal bridge asserted itself and the epicanthus disappeared.

Dr. STEWART (in reply) said that wrinkling of the brow of the mongol was not exceptional; at Leavesden he had seven patients in whom that was very well marked, and Dr. Brushfield had many photographs showing it. Therefore Crookshank was not altogether correct when he emphasized the smoothness of the mongolian child's brow.

The discussion had illustrated the lack of unanimity there was on this subject, particularly as to how it originated. He himself agreed with the opinion expressed that the disease was due to influences, partly hereditary and partly environmental. But, as Sutherland had said many years ago, the disease was so very distinctive that one could not help feeling that in every case the same cause was at work, that it was not a matter of syphilis causing it in one case and alcoholism in another. He, personally, held no brief for syphilis as a cause, but the French tended to exaggerate the importance of that disease in causation. It might be that the incidence of syphilis was greater in France than in this country.

It had not occurred to him to investigate the ages of the fathers; it was an interesting point that they should so often have been younger than the mothers.

He thanked Dr. Shrubsall for putting him right as to cases in the negro race; it had not occurred to him that the distribution of the Bushmen might explain the occasional occurrence

[1] "Mongolism in one of Twins and its Origin." T. Halbertma, *Amer. Journ. Dis. Child*, 1923, xxv. p. 350. "Mongolian Idiocy in both Twins. "A. Strauch, *Journ. Amer. Med. Assoc.*, 1923, lxxxi, p. 2181.

of mongolism in negroes. In the *Journal of the American Medical Association* a few months ago there appeared a very good illustration of a negro child showing all the characteristics of mongolism.[1]

He was glad Dr. Shrubsall had referred to Jansen's theory, because, though it had been quoted by many people, no one had ventured to criticize it. Knowing nothing about embryology himself, he wondered what the general view about it would be. It seemed to be rather an attractive theory, because there was a considerable resemblance between the achondroplast and the mongol.

Dr. Potts had stressed neuropathic taints in parents, but he (the speaker) doubted whether they were more common in these cases than in ordinary healthy families. He believed that everyone's family, if scrutinized closely enough, would show evidence of some neuropathic influence. The intestinal toxæmia view was one which might be adopted, but constipation and intestinal toxæmia were very common in pregnancy, and if they were a cause one would expect to see more cases of mongolism.

With regard to the point made concerning adrenal secretion, physiologists were coming to the view that there was no secretion of adrenalin taking place except under abnormal conditions, and that the ordinary healthy individual had no adrenalin entering the blood. He was also interested in the remarks about defective thyroid secretion in the mothers, because many French authorities held that this disease was in a large degree due to hypothyroidism in the mother. Many reports had been published lately in which that view was adopted.

The question of twin mongols was another interesting one. He believed that, so far, only two instances of mongols, both of the same sex, had been recorded, so that there was only a small number on which to base a conclusion.

What he meant when he said that the disease could be recognized in early intra-uterine life was, that he remembered reading accounts of early abortions; among which an American had found mongols not more than two months old.

He was tempted to ask whether, if it was not known that cretinism was due to absence of thyroid secretion the atavistic theory might not plausibly be extended to include the cretin, because the latter showed striking negroid characters. Writers emphasized differences between mongolism and cretinism, but the points of resemblance were almost as numerous, and he thought the cretin could be brought within the scope of that hypothesis.

He agreed with the President that the epicanthic fold was due to the failure of development of the nasal bones, and their absence had been noted in pathological examination.

He expressed his thanks for the favourable reception which had been accorded to his paper, and his appreciation of the kindness of Dr. Brushfield in lending his excellent slides.

[1] *Journ. Amer. Med. Assoc.*, 1925, lxxxiv, p. 1041

Section of Psychiatry.

President—Dr. R. H. Cole.

The Clinical Relationships Between Psychological Disorders.

By Thomas Beaton, O.B.E., M.D.

Clinical psychiatry is still the most empirical of sciences. It deals with morbid entities the very existence of which is open to doubt. Since this is so, no attempt to correlate the various recognized psychological disorders can be more than tentative, even if it can be justified at all. With this apology, I propose to set out a few instances, derived from clinical practice, of the inter-relation between some of the commoner mental disorders.

The diagnosis of clinical material in its early and highly uncertain stages is difficult, and prognosis is practically impossible. The clinician is usually content to adopt an expectant attitude and await developments. When, however, as at Bethlem Hospital, such cases have to be demonstrated and made the subject of practical clinical instruction, not only is it impossible to evade the problem of diagnosis, but the clinician is forced to give it an unusual amount of attention. Practical experience shows that the diagnosis of cases of short duration, which have not yet settled down into chronic institutional grooves, is a most difficult matter, so difficult in fact that the physician is constantly being challenged to criticize the views he holds on mental disorders, and to vary the angle from which he regards them.

In the first place, he learns that the majority of descriptive pictures apply only to certain limited phases of the patient's illness. It is unusual, for example, for the original diagnosis of an early psychotic case to be confirmed at the end of twelve months, and the symptom-complex of most patients changes considerably in the course of their illness. Sometimes the change in the clinical picture represents a further development of the same morbid process. In dementing psychoses generally, the final dementia is a development of the primary psychosis. In some cases, however, we have to suppose the blending of two distinct entities in order to account for the variation in the clinical picture. Within the biogenic group of psychoses, Bleuler has made it clear that the question is often not to determine whether a patient belongs to the schizoid class and should be regarded as a dementia præcox, or whether he belongs to the syntonic class and is a manic-depressive psychotic, but to determine how much of his reaction is schizoid and how much syntonic. Hoch, in his work on the benign stupors, emphasizes the same relationship between the two groups of psychoses by concentrating his attention on the one-symptom complex of stupor.

The relations of the toxic confusional group to the biogenic group are extremely interesting. Very many acute psychotic reactions of the adolescent and involutional periods of life are biogenic in type but they manifest symptoms of toxic confusional psychosis at some time or another in their course. The hypothesis that the confusional state has been superimposed by the development of toxæmia is supported by the concomitant change in the physical state of the patient.

On the other hand most confusional psychoses, the ætiology of which is unquestionably toxic, present a clinical picture resembling in its general features a biogenic disorder. Confused patients often exhibit the alternation of excitement and

stupor that indicates a syntonic tendency, or simulate the schizoid disturbance appropriate to their age. An adolescent toxic patient, for instance, will be distinctly præcox in his general demeanour.

The morbid reactions of the general paralytic are a good illustration of this double symptomatology. The usual age at which the parenchymatous syphilitic disease develops is about 35, the age at which the biogenic disorder known as paraphrenia is also likely to appear. In clinical practice the paretic patient generally passes through a pre-psychotic stage and then enters upon a stage in which he undergoes an expansion of the personality, and develops delusions of grandeur and hallucinations. In this he strongly resembles the paraphrenic, who passes from a pre-psychotic stage of unrest—ideas of reference into a similar stage of expansion of the personality with compensating delusional developments and hallucinations. Beyond this the comparison ceases, for the paraphrenic hardly ever dements so quickly as the general paralytic, whose cortex is being destroyed, and who may, in fact, die from some intercurrent physical illness before he dements at all.

Judged solely from its mental symptoms, general paresis is a different disease at different periods of life. The congenital paretic is essentially a special type of mental defection, the adolescent paretic is a dementia præcox, while in later life the clinical syndrome is much like that of an involutional psychosis.

An interesting adolescent case of general paralysis came under observation at Bethlem Hospital some few years ago. The patient had contracted syphilis as a boy of 15, and broke down at the age of 18 with what was at first thought to be a psychoneurosis. He was treated by psycho-analysis in a nursing home, but after some months his conduct became so disordered that he was placed under institutional care. He showed so little in the way of neurological signs that his real condition was not suspected for some time. Mentally he exhibited recurrent phases of excitement during which he evolved typical præcox phantasies. He had gleaned a certain knowledge of evolution from his course of psycho-analysis, and lived the story again in phantasy. He played at being a fish, a bird, a dog, and so on. He had mannerisms of behaviour and the impulsiveness of the young adolescent psychotic. Eventually suspicion was aroused, and laboratory tests revealed the specific infection. Under anti-syphilitic treatment he recovered sufficiently to leave hospital and take up some form of occupation.

There are many other points of interest in the inter-relations of the psychoses, but since they are largely concerned with questions of differential diagnosis they hardly come within the scope of this paper. The writer proposes to consider the practical relationships between the psychoses and the group of disorders called the psychoneuroses. Necessity is the mother of invention, and the necessity must have been extreme which induced psychiatrists to draw a sharp line between these two groups. Personally, I would be sorry to have to produce a definition which would satisfactorily cover either and yet exclude the other. Various differences are alleged, such as for instance the possession of insight, but it would be no more arbitrary than most definitions, and certainly more practical, to label as psychoneuroses those disorders found outside mental hospitals and as psychoses those found within them.

The anxiety syndrome is, under certain circumstances, a normal mental reaction. The man who is struggling to make headway against strong competition would not be normal if he were not anxious. In times of stress we are all anxiety neurotics, save those who have not sufficient intellectual capacity to appreciate the true significance of their environmental situation, but no one would use the term "neurosis" to describe our mental reaction. It is obvious that the anxiety state is a psychosis if the word is to have any meaning at all. Anxiety is recognizably morbid and pathological if it appears and persists when the circumstances do not justify it, and the syndrome is very common in clinical practice. In a certain number of cases the state of anxiety constitutes the whole of the psychological disturbance, and we know

that in many of these the reaction is due to some organic disturbance within the organism, the condition of exophthalmic goitre, for example. In other patients we assume that the condition is the result of biological stress. The point which the writer wishes to make is that only the milder cases, in which the patient is still able to control the outward expression of his emotional disturbance, fall within the limits of the conception of "psychoneurosis." Quite a number of anxiety patients lose their capacity for self-control and develop severer reactions with secondary delusions and hallucinations. A truer name for this condition is "acute, agitated melancholia." Again, a mild anxiety state may persist for some time and then be followed by a secondary depression not of the anxiety type, a response to the intolerable life situation in which the patient finds himself.

Apart, however, from cases in which the anxiety syndrome is the primary disturbance, it is sometimes found to be secondary to other psychotic disturbances. Almost any kind of psychological disorder has a phase in which the patient is confronted with difficulties new to him which he cannot understand, and, until he is too confused to think, or until he has effected an adequate rationalization, he may exhibit a morbid anxiety.

The writer has known the clinical picture even of the more definitely psychotic developments to be obscured by the development of the anxiety syndrome. Not uncommonly the paraphrenic or the involutional patient, disturbed by the distortion of his perceptive life, undergoes a serious anxiety state at the outset. A man of 40, who had been suffering with ideas of reference for about twelve months and had gone about his business feeling that he was being continually watched and followed, eventually broke down with an acute anxiety state. He was restless and tremulous, and presented all the symptoms of acute agitated melancholia. On being placed under institutional care—where he felt "safe," as he put it himself—the whole syndrome cleared up in the course of about three months, but the underlying psychosis steadily gained ground and he eventually passed into the state of exaltation with rationalizations, which is characteristic of paraphrenia. The compulsion neurosis is a situation which contains many anxiety-producing factors, and few of its patients are free from anxiety. Many, in fact, suffer from anxiety in a marked degree, and the presence in one patient of both anxiety and compulsion state are apt to make diagnosis very difficult.

Psychasthenia, or the obsessional state, may be complicated by the anxiety syndrome, but what is not so generally recognized is that a case which persists for a long time tends to undergo a complete transformation. In the experience of the writer, the obsessional psychoneurosis has two possible mental sequelæ. One of these is the development of a resistive depression, which may be regarded as the patient's reaction to his obsessional state. He finds his freedom of action gradually becoming more and more restricted, and this growing sense of limitation increases his depression until in the end he lies inert, antagonistic to any stimulus from the environment, and overcome by "black despair." A great number of cases of resistive melancholia would show a previous history of obsession if they were examined.

The second sequel is more interesting psychologically, because it illustrates the working of a compensatory mechanism of projection. It is not uncommon for the obsessional patient between the ages of thirty and forty to develop hallucinations. The subjective impulse becomes projected on to the environment and the result is a chronic hallucinatory psychosis. The patient retains his intellectual clarity and does not develop delusions, but, whereas he previously felt irresistible impulses arising from within, he now hears imperative commands. Instead of having to repeat obscene words to himself, he hears them shouted at him or sees them written up around him. The histories of chronic hallucinatory cases always reveal a pre-existing obsessional state and, as in the obsessional case, the chronic hallucinated patient generally develops a resistive melancholia as his final psychological reaction.

Hysteria presents a difficult problem to the clinical psychiatrist. The hysterical syndrome is certainly a distinct entity, but whether it possesses the same significance as a disease process—as, for instance, the obsessional state—is very doubtful. The tendency to react hysterically, in other words, to influence the social environment by an emotional display, or to rely upon incapacity as a method of evading social responsibility, is present in nearly everyone, and the more dependent a person is, the more liable is he to behave in this way. It is not surprising, therefore, that we find hysterical symptoms in the clinical picture of practically any disorder, physical or mental. The functional fringe which nearly always surrounds an organic nervous disorder is an example. Only cases of stupor, advanced cases of dementia, determined cases of catatonia or resistive attitudes, and the self-reliant paranoiac are completely innocent of any appeal for sympathy.

It seems absurd to attempt to diagnose between hysteria and dementia præcox or manic-depressive psychosis in most adolescent patients. Their behaviour is often manifestly hysterical at the outset, but as the deterioration of the schizoid psychosis gradually progresses under cover of the hysterical picture, and the alternating phases of the syntonic disorder run their course independently of the behaviouristic response, the real disorder gradually becomes apparent.

To label hysteria as a psychoneurosis and treat it as a minor functional disturbance is to bury one's head in the sand. Even the pure hysteric, with no other trouble of any kind, can be as difficult to deal with as the most serious psychotic, as many physicians have found to their cost.

These few observations, based upon the practical work of clinical psychiatry, are put forward, as it were *de profundis*, to illustrate some of its difficulties. It is not surprising that our conceptions are difficult to apply. Clinical psychiatry is a many-sided figure, which cannot be represented in a single picture. Many nosological conceptions are not related to each other in any way. The conception of the psychoneuroses has been developed from the point of view of organic neurology, that of the psychoses was invented by the psychologists, while that of the toxic psychoses is based on the principles of general clinical medicine. The investigations of Sir Frederick Mott have given us a definite pathological basis for our conception of dementia præcox, and it is probable that the symptom complex is largely adventitious, just as the clinical syndrome of the general paralytic is in no wise related to the actual progress of the disease, except that the dementia goes hand in hand with the cortical degeneration. The appearance of a mental disturbance such as, for example, morbid anxiety, is a signal that somewhere there is a failure within the organism or in its relationship with its environment. It is our business to find the point of failure, to relieve the actual strain, and not to be satisfied that because we have discovered a syndrome we have done all that is required of us.

[*April* 13, 1926

Cerebral Arterio-sclerosis.

By G. W. B. James, M.C., M.D.Lond., D.P.M.Lond.

The subject this evening is one of great and growing interest. I propose to place before you some of the features of the condition, illustrated, where possible, by a series of twenty cases, most of them being drawn from private institutional practice. All these twenty cases were non-specific; examinations of the blood and cerebrospinal fluid in all but two cases excluded syphilis as a causal agent. The two remaining cases may both be confidently accepted as being non-specific.

Sclerosis of the cerebral vessels may be a part of a general arterio-sclerosis, from causes which we shall discuss later. But cases occur in which the cerebral vessels appear to be the chief field of operation for the sclerotic process. Many authorities [1] are agreed on this point; most mental hospital physicians can recall

cases in which a profound degree of dementia has been attained, with very little evidence of general arterio-sclerosis. No principle of the order in which arterio-sclerosis invades the body has been formulated. Mott [2] gives the cerebral arteries as fifth in order of occurrence in a list of eleven seats. Thoma [3] places the cerebral vessels fourth in a list of fifteen seats of arterio-sclerosis. Both authors agree that the limbs are the most frequent sites of arterio-sclerosis.

A common misconception must be corrected in approaching a study of the subject. There is a very usual tendency to regard arterio-sclerosis as a disease. It is no disease entity in itself. Arterio-sclerosis is one of the manifestations of many disease processes, some of which remain obscure.

The signs and symptoms of cerebral arterio-sclerosis show great variety. They depend upon two main factors: the distribution and intensity of the sclerosis, and the occurrence of results dependent upon the sclerosis—hæmorrhage, thrombosis and, rarely, embolism.

The site of the arteries affected will determine the tones of the clinical picture. Thus, sclerosis of the basilar artery is likely to produce bulbar symptoms, cerebellar symptoms arise from sclerosis of the cerebellar vessels, while paralytic symptoms are very characteristic of lesions of the middle cerebral or its branches.

Many attempts have been made to classify the signs and symptoms of cerebral arterio-sclerosis; there are almost as many methods as authors. The lesions possible are numerous, and while the commoner signs and symptoms are fairly well known, a great many atypical cases are constantly appearing in the literature.

Alzheimer described several such; Uyematsu [4] has written recently of a woman whose condition suggested brain tumour, though a careful necropsy revealed a severe cerebral arterio-sclerosis. Jacobson [5] has published a case suggesting progressive bulbar palsy. For convenience I have divided the subject into two stages, the first being the initial or pre-hospital stage, and the second dealing with the later conditions seen in hospital cases.

Early Signs and Symptoms.

It is perhaps unfortunate that so many of our descriptions of signs and symptoms have been produced from hospitals. For when a cerebral arterio-sclerotic arrives at a hospital, often on account of a gross disturbance of conduct, his disease has progressed far. In my twenty cases I investigated carefully the history of the illness, with special reference to the earliest signs that were noticed by relatives and friends. Twelve of the patients were themselves able to give a very clear account of their own early troubles; in the remaining eight the evidence was untrustworthy. It was found that signs and symptoms had been in existence for an average of five years before admission to hospital. Some of the cases had a history extending over nearly ten years and one or two over more than ten years.

The signs observed by others, and the symptoms complained of by the patients, were partly physical and partly mental. Two showed a period of elation, a fact of great interest, because the late Sir Clifford Allbutt has recorded [6] that in the earlier stages of hyperpiesis patients may develop a sense of well-being, probably accounted for by a richer supply of blood to the brain. These two cases are worth quoting in some detail. Both were males. The first (Case VI), thirteen years before his condition necessitated hospital care, began to dress extravagantly, had a suit and a hat for every day in the week, and, though married and with a growing family, began to consort with prostitutes, finally contracting gonorrhœa. The elation lasted about six months, when he settled down, shortly afterwards complaining of headaches, which continued intermittently until much graver focal symptoms occurred three years before admission.

The second case (Case V) ten years before admission showed an elation which led him to spend money and to speculate extravagantly. He also developed

vertical head pains and an anxiety and depression which suggested the true state of affairs.

The signs noted by the friends included increasing irritability and emotional incontinence at home; depression, and a tendency to delusions of ruin and hypochondriasis; marked mental and physical fatiguability, somnolence during the day, and severe insomnia at night. Almost all the near relatives insisted that there had been a change of character spreading over a varying term of years. They said that the patient "was not like himself," had "lost interest" in domestic and business affairs; and notably frequent was the complaint that the sufferer had shown a loss of affection, and replaced an amiable character by an irritable obstinacy, and even brutality. Of the early symptoms complained of by the patients I have recorded the following:—

Three dated their illness from observing an increasing intolerance of their usual quantities of alcohol, tea or coffee, which produced an unaccustomed palpitation. One noticed that sexual intercourse was followed by violent and prolonged palpitation and insomnia. One complained of a vertigo which occurred first on the golf links, while addressing his ball on the tee. Three observed an increasing inability to perform routine work, and a tendency to sleep at their desks. Two informed me that their first symptom was a transient difficulty in speech, in one after a long motor drive, and in the other after making a speech at a meeting. Two noted as their first complaint a morning headache, which was relieved as the day advanced. Most of my twenty cases had sought medical aid and had received very various advice. Some were sent for holidays, a few had been recommended to spas, several had evidently been regarded as neurotics, one having undergone a course of psychotherapy.

There is no available record in these cases of the condition of the retina before admission. No certain relationship has yet been established between the condition of the cerebral vessels and those of the retina. Foster Moore [7] published in 1916 a study of retinitis in arterio-sclerosis. In nearly 50 per cent. of his cases the patients afterwards died of a cerebral lesion. Foster Moore concludes that the relation of the retinal vessels to the cerebral vascular condition is a close one. It is reasonable to suppose that the retinal vessels may assist as guides to the condition of the cerebral vessels. In the more advanced cases of cerebral arterio-sclerosis retinal changes occur, to which reference will be made later. To summarize: the early stage of cerebral arterio-sclerosis is rich in symptoms, but poor in signs.

Common complaints are: Vertical headache, worse in the morning, palpitation, and substernal pains on exertion. Fatiguability, both mental and physical, vertigo, intolerance to stimulants, depression, emotional lability, especially irritability of temper, and in many cases a progressive change of character. Psychic discomfort may express itself in delusions of ruin or bodily disease, and apprehension and anxiety are commonly found. In addition, transitory disturbances of sensibility in the extremities may be noticed, and very significant are passing motor failures, a fleeting loss of power in arm or leg, a momentary aphasia, or apraxia. Short periods of confusion occur, and patients sometimes wander away from home. This confusion often takes place at night. Sleep is disturbed, and an intractable nocturnal insomnia is associated with somnolence by day. These symptoms may be present over a number of years, varying from one or two to ten or more. Personal cases draw attention to the changes in character. Tamarin [8], in a series of four cases published in 1913, called attention to similar alterations in character. The signs found on examination in this first stage are scanty. Tortuous and palpable peripheral vessels—for example, the radials and temporals—must not be taken as indicative of the condition of the cerebral vessels.

The converse is also true. Advanced cerebral arterio-sclerosis may exist with apparently healthy peripheral vessels. Spielmeyer attaches some importance to what

is known as Spielmeyer's sign. If a patient be placed with the head and trunk flexed for thirty seconds, on his regaining the upright position, the temporal artery is seen to stand out as a tortuous and knotted cord. This sign can undoubtedly be obtained in most cerebral arterio-sclerotics, but is often apparent in healthy persons. Deep reflexes vary, but inequalities on the two sides are occasionally found without hemiplegia, or other gross lesion. The sphygmomanometer may reveal high systolic and diastolic blood-pressures. On the other hand, blood-pressures may not be above normal, and may even be low. Cardiac hypertrophy may be present, but is usually a much later occurrence. Albuminuria is present in those cases of hyperpiesis secondary to renal disease. Arcus senilis was present in fifteen of the twenty cases under review, but is seen in many normal persons, and, as a sign of sclerosis of the cerebral vessels, must be accepted with great reserve. The pupils seldom show marked change in the first stage. Weiner and Wolfner [9] have stated that in cases of high blood-pressure the pupil, on exposure to light, contracts first, and then dilates, even though the application of light be continued. This reaction appeared in three personal cases, at a later stage of the condition. When pupillary changes in early cases are observed, the most frequent findings are pupils sluggish to the light reaction, or a bilateral myosis.

The Second Stage.

This is the stage in which most patients come under the notice of the hospital physician. The lesions that occur are more apparent; changes of character and conduct often necessitate removal from home surroundings.

Table I.—Illustrating the Onset of the Second or Hospital Stage in Twenty Cases of Cerebral Arterio-sclerosis.

Case I.—Mental confusion, wandering from home, and delusions of ruin and sin.
Case II.—Confusion, violence at home, wandering, aphasia following slight hemiplegia.
Case III.—Irritability, resistive to ordinary care, ideas of poisoning and refusal of food.
Case IV.—Hemiplegic stroke, confusion, weeping at trifles, thought he was a prisoner of war (1920).
Case V.—Laughing and crying at trifles. Worried neighbours with his suspicions of being ruined and shadowed.
Case VI.—Irascible and dangerous at home, wandering and could never be left.
Case VII.—Hemiplegia accompanied by noisy delirium.
Case VIII.—Suicidal attempt, refusal of food, due to delusions concerning his intestines.
Case IX.—Transient excitement, sexual colouring.
Case X.—Excited restlessness, hypochondriacal delusions.
Case XI.—Noisy restlessness, depressing fears of ruin, suicidal attempt.
Case XII.—Delusions of infection, fears of incontinence.
Case XIII.—Confused, excited and abusive, slight aphasia, marital suspicions.
Case XIV.—Confusion, ideas of being shadowed, refusal of food.
Case XV.—Not under care.
Case XVI.—Not under care.
Case XVII.—Irritable, abusive and violent at home.
Case XVIII.—Marked confusion, motor aphasia, violent at home.
Case XIX.—Confused, depressed, lachrymose, ideas of ruin.
Case XX.—Delirium with hemiplegia.

In my series of twenty cases, confusion and wandering from home and difficulty of control were the troubles leading to removal in eight cases. In three the patients became irritable and violent at home. In three more a sudden hemiplegia was accompanied by a wild delirium. Three patients showed a tendency to abstain from food under the influence of hypochondriacal ideas, and delusions of poisoning. One showed a restless excitement, accompanied by a tendency to sexual adventures. Table I shows the manner in which the second phase of the disorder began in these patients. Table II gives a list of the twenty patients; two patients are included, one a male, the other a female, who have not required hospital care.

TABLE II.

No.	Sex	Year of admission	Age on admission	Age on first symptom	Family history	Systolic B.P.	Diastolic B.P.	Cardiac hypertrophy	Albuminuria	Retina	Termination
1	M	1919	62	56	No	200	140	No	Trace	2	D, 4 mos.
2	M	1920	67	62	Yes	180	130	Yes	Nil	2	D, 9 mos.
3	M	1920	52	50	Yes	160	90	No	Nil	1	L
4	M	1920	55	52	No	208	120	Yes	Trace	2	D, 3 yrs.
5	M	1921	65	55	No	210	110	No	Nil	1	L
6	M	1921	61	48	Yes	180	No record	Yes	Nil	2	D, 3 yrs.
7	M	1921	52	45	Yes	260	No record	Yes	Nil	2	D, 2 yrs.
8	M	1922	50	48	Yes	120	70	No	Nil	1	D, 4 yrs.
9	M	1922	58	50	No	180	100	No	Nil	2	L
10	M	1923	59	55	No	200	90	No	Nil	1	L
11	M	1923	53	50	No	140	80	No	Nil	1	L
12	M	1924	63	59	No	120	75	No	Nil	1	L
13	M	1924	65	60	No	190	120	Yes	Trace	3	D
14	M	1924	66	63	Yes	200 / 140	120 / 80	No	Nil	2	L
15	M	—	48	48	Yes	180	90	Yes	Nil	1	L
16	F	—	49	49	Yes	240	120	Yes	Trace	No record	D
17	M	1916	54	52	No	140 / 180	70 / 90	No	No	2	L
18	M	1923	59	58	No	280	160	No	Trace	3	D, 7 wks.
19	M	1922	50	49	No	180	80	No	No	2	L
20	M	1923	55	50	No	230	140	Yes	Trace	3	D, 3 mos.

Table II shows the age on being first seen, the age at which symptoms or character changes were first observed, and a record of the blood-pressure, systolic and diastolic, together with the presence or absence of cardiac hypertrophy and albuminuria. The last two columns indicate the condition of the retinæ and the termination of the case. A glance at this table shows that the cases can be divided into two groups. The first of these groups shows high blood-pressures, accompanied in some cases by renal damage and cardiac hypertrophy. These cases for the most part had a rapid course and showed severe focal lesions. The other group shows lower pressures, on the whole an absence of severe focal lesions, and no rapid progress to severe dementia and death.

This clear division of the cases is important, and I give here the clinical classification of arterio-sclerosis suggested by the late Sir Clifford Allbutt [10]. He divided arterio-sclerosis into four groups :—

(1) Associated with granular kidney.

(2) Toxic arterio-sclerosis, and associated with typhoid, syphilis, diabetes, lead and other infectious diseases and poisons.

(3) Decrescent arterio-sclerosis, the form associated with involution, senility or presenility.

(4) Arterio-sclerosis, associated with persistent high blood-pressures of obscure origin, a condition he called hyperpiesia, a term now in general use.

Most cases of cerebral arterio-sclerosis (apart from syphilis) seem to fall into the last two groups. The decrescent cases show much less disturbance of pressures, and the disease may reach the stage at which it may remain stationary for years. The hyperpietic cases, showing high pressures, possibly renal damage, and cardiac hypertrophy, run a much more rapid course—though there are exceptions—and almost invariably suffer a series of focal lesions, generally hæmorrhagic.

A word must be added concerning the presence of albumin in Cases I, IV, XIII, XVI. It might be thought that a primary kidney lesion was the governing factor in the high pressures present. The urine of these cases had a fairly high specific gravity. Casts were of rare appearance and the albumin constant. Blood nitrogen was not estimated.

A primary granular kidney produces a large quantity of urine of low specific gravity, abundance of casts, and the spasmodic appearance of albumin. The post-mortem appearances of the kidneys of three of these cases did not suggest the picture of granular kidney. The changes were slight, and the albuminuria appears to be best explained as the result of interstitial degeneration, often localized, resulting from sclerosis of the renal vessels or possibly from a renal catarrh, the result of some chronic infection.

An examination of the columns showing the blood-pressures indicates several points of interest. In the main the progressive cases show high systolic pressures, but perhaps, from the point of view of prognosis, the diastolic pressures are more important. The series illustrated show, in the majority of the progressive fatal types, a high diastolic pressure 120 mm. or more. This is clearly demonstrated in Cases I, II, IV, XIII, XVIII and XX. Although a series of twenty is too small to warrant any general conclusions, it would seem that a high diastolic pressure, 120 mm. or more, is of grave prognostic import. But not all of the progressive cases showed high pressures. Case VIII is an example. Here the blood-pressures were quite normal, and yet a fairly rapid course, accompanied by focal lesions and epileptiform seizures, led to a fatal termination in four years.

The column labelled "Retina" refers to the condition of the retinæ. The numbers 1, 2 and 3 occurring in this column refer to an attempt to classify the retinal changes into three stages or classes. These three stages cannot be sharply distinguished, and are only the expression of a rough rule-of-thumb method of classification.

FIG. 1.—Diagrammatic representation of retinal artery crossing a vein. Note blanching of the vein, and swelling of the distal portion of the vein. (After Chavasse.)

(1) Indicates the lightest change seen on admission. The arteries are no longer seen as clear columns of blood, but are paler and straighter than normal. There is knuckling of the veins where crossed by the arteries, and there is a diminution of the blood-stream through the vein.

(2) Shows a further stage. Here the arterial twigs are "corkscrewed," there is a diminution of lumen in the arteries, a silver wire appearance is observed here and there, and the veins, where crossed by the arteries, are not only diverted from their paths, but show blanching on either side of the arterio-venous crossing. On the

near side of the vein ampulliform swellings are sometimes seen, as if the blood were dammed back.

(3) Shows the most advanced stage in which the arteries have a marked silver wire appearance and narrowing of the lumen, and in some areas become a fibrous streak. Hæmorrhages occur on the surface of the retina, and the disc sometimes

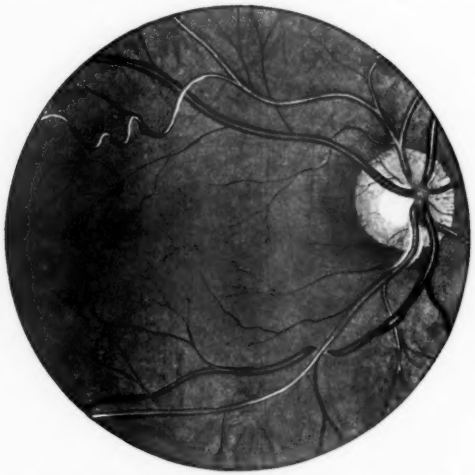

FIG. 2.—Showing retina in second stage. Note silver wire, corkscrewed arteries, and typical arterio-venous crossing. (After Chavasse.)

appears œdematous and often atrophied. The atrophy is accompanied by the failure of vision nearly always found in late phases of cerebral arterio-sclerosis.

I am privileged to be able to show you some illustrations of arterio-sclerotic changes in the retina lent to me by Dr. Bernard Chavasse, M.C., of Liverpool, to whom I would express my grateful thanks.

THE COURSE OF THE SEVERE PROGRESSIVE FORM.

I shall not attempt detailed clinical descriptions of conditions which occur in the course of these progressive cases. Imperception makes rapid strides. There is marked emotional incontinence, trivial stimuli will produce outbursts of tears or laughter, which in occasional cases become compulsive and uncontrollable, especially after an apoplectiform or epileptiform seizure. The prevalent mood is one of sadness with melancholic delusions, and occasionally suicidal attempts are made. Apprehension is nearly always present, and it is a common experience to find on doing some simple operation such as venepuncture, or a blood-pressure record, that the patient fears he is to be tortured or put to death. Motor aphasia is usual, syllables and words are mixed in sentences which have no apparent meaning. Apraxia and agraphia develop in most of these progressive cases, and may at first be transient. Severe vomiting occurs from time to time, and can be relieved by repeated lumbar puncture (as, by the way, most of the epileptiform attacks can be relieved).

Deafness was noticed in Cases I, IV, and XIII. In Case IV the patient complained of tinnitus. The deafness progressed with time, but was never complete.

Vertigo is often complained of in the second stage. The station becomes insecure, the gait uncertain. The expression is immobile and inanimate, so much so that Sir Frederick Mott has pointed out that an early cerebral arterio-sclerotic may be confused clinically with the sequelæ of encephalitis lethargica. The patient stands on a wide base, walks with short spastic strides, and performs turning move-

ments slowly, and with a characteristic abduction of his arms as if he were "feeling his way." Coarse tremors of the hands sometimes hinder the taking of food. In the later stages, patients of this class may require feeding, as they are unable to appreciate the use of table utensils. Several examinations of sensation were made on the first six cases of the series shown. The results were conflicting and unsatisfactory. If any conclusion could be drawn, it was that there was a progressive deterioration of the discrimination of stimuli. Heat stimuli, for example, were described as painful but not hot, or possibly as cold. But the answers were so conflicting that no reliance can be placed upon the findings. The pupillary changes showed wide variation. Of the nine institutional cases of the progressive form, inequality of the pupils was found in four, irregularity in outline in four, a very sluggish reaction in six, and myosis in two. In none was the Argyll-Robertson reaction obtained.

The numerous paralytic lesions which occur in the course of the disease are produced most often by hæmorrhages, which may be minute or extensive. The paralysis, aphasias and sensory losses may be transient or permanent. A hemiplegia is most often seen. Hemianopia occurred in one of the series, Case VII.

There remains the still much discussed problem of epileptiform attacks. Of these there are two kinds, one resembling what is known as idiopathic epilepsy, the other resembling Jacksonian attacks, with slight clouding of consciousness, and the convulsive movements confined to one set of muscles. These epileptiform attacks occurred in two of my twenty cases (10 per cent.). Price [11], in a recent series, found that epileptiform fits occurred in 16 per cent. In Case VIII of my series the early clinical picture was indefinite. The patient was depressed and had many delusions of bodily decay. He was fearful of immediate dissolution. He was pale, but the temporal arteries were not noticeably tortuous or palpable. The retinæ showed pale straight arteries blanching the veins at the arterio-venous crossings. Four months after admission he suddenly fell in a typical epileptic fit, ushered in by a cry and followed by tonic and clonic spasms, passage of urine and a heavy comatose sleep. This patient in all had about twenty fits in three years. There seemed little intellectual disturbance until towards the end, when he became demented and doubly incontinent. Death was due to pneumonia, and a macroscopic examination of the brain revealed numerous foci of hæmorrhages of various dates situated in the medullary regions of the frontal and parietal areas. There were also hæmorrhagic scars in the right thalamus and corpus striatum.

Authorities agree that the transient aphasias and loss of motor power are due to minute hæmorrhages. The case cited suggests that rupture of the finer branches of the medullary vessels may be associated with epileptiform attacks.

The progressive cerebral arterio-sclerotic is often surprising in the insight that he retains into his condition. Moreover, personality persists, until late in the disease, and although he is unable to record fresh impressions, being utterly lost in his relations of time and space, he will retain an interest in family and business affairs. The last stage, however, finds him in a state resembling the terminal phases of general paralysis.

The Second Stage of Cerebral Arterio-sclerosis in the Decrescent Group.

It was noted that in these decrescent cases systolic and diastolic pressures were lower than in the first group. Further, renal damage and cardiac enlargement were notably absent. Lastly, most of the sufferers are still living.

These patients show the emotional lability, the loss of memory, the vertigo and other symptoms of the first group, but in most cases the grosser focal lesions are absent. The progress of the disease is slower, and seems very often to be arrested, so that a "ripe old age" may be reached under suitable conditions. It may

be objected that some of these cases belong properly to late manic-depressive states, schizophrenia or paraphrenia. None of them record a history of previous attacks, and in most some obviously cerebral lesion has occurred; such lesions have been transient aphasias, attacks of vomiting or pareses, from which a rapid recovery has been made. In one case the patient complained of lameness on walking, a symptom which suggested intermittent claudication. Rest restored the motor power.

Two cases of this group show œdema of the lower extremities on standing or walking. Such signs are not uncommon in both groups, and suggest either a sclerosis of the arteries of the limbs and ischæmia of the tissues—the most probable explanation of intermittent claudication—or else a disturbance of the vasomotor apparatus.

Cardiac insufficiency was not apparent in the two cases quoted, and the urine was free from albumin. Mentally, the patients of the decrescent group show a slow failure of intellectual power, closely resembling the gradual decay of advancing age. Three of the series show well-marked peripheral arterio-sclerosis, the others exhibit less evidence in the peripheral circulation. But visceral signs seem to be more frequent in the decrescent group. Fainting is common in four of the series, and in one the patient had anginal attacks.

There is one aspect of the decrescent cerebral arterio-sclerotic which deserves mention. In two of the cases of my series I have taken blood-pressure readings at regular intervals and found that a rise of both systolic and diastolic pressures occur from time to time. In the first of these the patient, a male, is accustomed to become irritable, dictatorial and meddling, even violent, once or twice in a year. These periods correspond to a well-marked rise of pressures. The other patient becomes confused, cannot find his way about and is restless and sleepless at night. Here again a rise of pressures occurs. These episodes of hyperpiesis in decrescent cases are periods fraught with danger to the life of the patient.

Pathology.

The pathological findings in cerebral arterio-sclerosis are described in a somewhat confused way and an imposing nomenclature suggests that the whole subject bristles with difficulties. There are a few elementary facts which govern the pathological changes described.

The cerebral arteries present certain special characters. At the base of the brain the vertebrals and internal carotids communicate freely by means of the circle of Willis. The branches of the main cerebral vessels are of small size, with comparatively thin walls and minute capillaries. These branches are divided into two groups, the basal and the cortical. The basal vessels supply the great ganglia and the medullary substance of the brain, and are end or terminal arteries, exhibiting little or no anastomosis. The cortical branches, on the other hand, cover the cortex like a thick vascular mantle, anastomosing freely, and ramifying extensively in the pia before entering the cortical substance. If we add to the general characteristics the facts that cerebral vessels are surrounded with wide perivascular spaces, and that the substance of the brain provides very limited support to its vessels, we shall appreciate more readily the changes that occur in cerebral arterio-sclerosis.

Lesions appear to affect chiefly the cortical, or chiefly the basal arteries. The names of Alzeimer and Binswanger are associated with the description of the microscopic appearances of arterio-sclerotic brains. In practice the lesions found are nearly always mixed, partly cortical and partly medullary. In an interesting article Kashida [12] insists that the correlation of clinical and pathological change is impossible. The points of predilection for the sclerotic process in larger vessels appear to be the deeper layers of the medulla of the mid-brain, the operculum and island, the striate nucleus, the ganglia of the pons and the dentatum of the cerebellum.

The two types of pathological change cannot be sharply separated, but the cortical type is chiefly seen in the class of cerebral arterio-sclerosis here termed "decrescent."

The second type with its extensive subcortical degeneration, and evidences of old hæmorrhages at all stages, is seen in the brains of the hyperpietic class of patient, with high blood-pressures, and in many cases a rapid progressive course.

No light seems to be thrown on the problem by the distribution of the lesions in these two types. Why should the cortical vessels be chiefly affected in the first group, while the medullary vessels seem to be selected in the second? Can the differences be attributed to the lack of anastomosis seen in the medullary vessels, in contradistinction to the free anastomosis of the cortical vessels in the pia; or are the high pressures in hyperpiesis chiefly responsible? Knape [13], in a discussion of the post-mortem findings in cerebral arterio-sclerosis, concludes that slowing of the blood-stream resulting from neurovascular disturbance is an important factor, but leaves the question open. Another pathological problem which is still far from solution is the order of the changes that occur in the walls of the vessels themselves. The arteries of the body can be divided into large, medium and small. The vessels of the brain are of the medium and small variety. The three coats of the arteries, adventitia, media, and intima, are affected in an order which does not yet seem to be settled.

The cerebral vessels have a poor adventitia surrounded by a perivascular space. Their thickness is slight, the media not showing a depth parallel with the smaller arteries of the limbs. While apparently brain vessels are less able to bear sudden rises in blood-pressure, it is obvious that they are not subjected to the longitudinal tensions that the arteries of the limbs must withstand. In cerebral arterio-sclerosis, diffuse, as distinct from nodular, changes in the intima are the rule. The first lesion appears to be in the intima, which hypertrophies. Degenerative changes occur in the deep layer of the intima, with splitting of the elastica, and fatty deposits followed later by calcareous deposits over which the endothelium may be lost. The media may show muscular hypertrophy in some specimens [14], possibly a reaction to high pressure. Authorities are not agreed as to the appearance of real muscular hypertrophy. Fibrous overgrowth, atrophy, and hyaline changes certainly occur in the media.

Thoma [15], in a difficult study of the lesions and mechanics of arterio-sclerosis, still maintains that the first arterial change that takes place is a passive dilatation of the vessel, probably the result of a hypothetical metabolic disorder. This dilatation he terms "angiomalacia." The second stage of the process is a proliferation of the vasa vasorum in the adventitia and outer layers of the media. This proliferation is followed by intimal thickening and increase of connective tissue in the media. Thoma also insists that the thickening of the intima is in part, at any rate, the expression of local disturbance of metabolism caused by a slowing of the peripheral blood-stream. Thoma's views have many opponents.

The changes in the vessels present many problems, mechanical and histological.

Cerebral arterio-sclerosis in some degree appears to be almost a normal occurrence in old age, probably largely the result of wear and tear and mechanical stress. Some cases in my series seem to show that a premature arterio-sclerosis of the decrescent type appears at a comparatively early age.

The Ætiology of Cerebral Arterio-sclerosis.

It may be said at once that there is at present no explanation of the selection of the cerebral vessels that is sometimes seen. Curschmann [16] and others think that cerebral arterio-sclerosis is generally only seen in association with similar lesions of the visceral and skeletal circulation. The causes underlying brain arterio-sclerosis will therefore be those found in general arterio-sclerosis, with possibly some localizing factor which is not known, any more than the exact ætiology of arterio-sclerosis in general is known.

In this connexion there is one point on which discussion might be productive, and that concerns the functions of the choroid bodies. These structures seem to have been little studied in relation to the changes which are found in them in clinical types of cerebral disease. Morowoka [17] has made a study of twenty-six post-mortem specimens of the choroid plexus, a series in five of which arterio-sclerosis was present. In all he found hypersecretive phenomena in the epithelial cells of the choroids with proliferation of the epithelium and formation of pseudo-colloidal cysts. Both epithelium and fibrous proliferation showed the presence of cholesterol in excess. This cholesterol excess has also been found in the blood in conditions of hypertension, by Westphal [18] and others; its rôle seems uncertain, but these similar findings may suggest that the choroid bodies play a greater part in the production of cerebral arterio-sclerosis than is at present suspected.

The influence of wear and tear seems fairly well established. Romberg formulated the doctrine that arterio-sclerosis attacks first that region in which there has been most exertion. There is evidence to establish the influence of mechanical stresses on the vessels of the limbs. Heavy manual workers show a premature sclerosis of the vessels of the limbs. The short lives of certain athletes are noteworthy, for example, those of the champion ski-runners and of the pelota players of the Basque country. But there is no evidence to show that brain workers are unduly liable to cerebral arterio-sclerosis. The evidence is rather to the contrary. Intellectual labour often appears to be associated with unusual longevity.

Renal disease may be associated with high blood-pressures, the granular form is always so. But that hyperpiesis is always of renal origin is a hypothesis which is impossible to maintain. The hyperpiesis of renal disease is almost certainly dependent upon lesions of the Malpighian bodies. Renal lesions in scarlet fever produce marked rises in pressures. Strickland Goodall [19] has stated that the most frequent antecedent of a high blood-pressure in the case of patients under forty years of age is scarlatina. Apart from renal disease, hyperpiesis as a factor in arterio-sclerosis has an obscure ætiology. Diet has been blamed, especially habitual overfeeding and the ingestion of excessive proteins.

Dr. Horatio Wood upheld the diet theory in a striking sentence: "Nine-tenths of the American people," said he, "dig their own graves with their teeth."

The dietary control in treatment, however, gives disappointing results. Further, many of the products of chemical action in the large intestine known loosely as "intestinal toxins" are depressor in action [20]. Obesity has been said to influence high pressures. Of my twenty cases, ten were stout and ten were slim. One or two were very spare, one or two were very fat. Obesity, so far as it may be due to an error in metabolism, is possibly a factor in arterio-sclerosis. Progressive loss of weight by the stout patients in my series was a signal for a rapid deterioration. Those hyperpietics who recovered sufficiently well to go home, maintained their weight fairly well, except for the results of a modified dietary. Gout, alcohol and nicotine have all received attention, but are not now generally accepted as causal factors. It cannot be denied that gross feeders generally accompany their meals by copious alcoholic drinks. Further, there is a tendency to cerebral lesions in gross feeders. History records numerous examples. My series of cases throws little light on the connexion between good living and cerebral arterio-sclerosis. In Cases II, III, VIII, X, XVII and XIX, the patients were undoubtedly accustomed to large meals, rich in proteins, and, in all but Case III, accompanied by alcohol in some form. On the other hand, in Cases I, III, XV and XX, the patients were teetotallers, and several others of the series had been spare eaters. "The honours seem even."

Staemmler [21], in an examination of thirty-eight cases, concludes that the rôle of the sympathetic system has been neglected. He lays stress on the infection element, and found in twenty-eight out of the thirty-eight cases examined that there was an atrophy of sympathetic ganglion cells which showed evidences of chronic

inflammation. The inflammatory influence on the ganglia would be irritative, at any rate at first. The chain of events according to this author is, therefore, infection, inflammatory irritation of the sympathetic ganglion, sympatheticotonus, hyperpiesis, arterio-sclerosis.

The rôle of acute infectious diseases in this connexion is well known, but the resultant disease of the vessels is, strictly, an arteritis and not arterio-sclerosis. That is why syphilis was excluded from my series. Still, there may be remote effects of an old infection, and it is probable that infection is an important agent in the genesis of arterio-sclerosis whether of the decrescent or hyperpietic type. Emotional factors, such as worry and anxiety, must be given a place in discussing the ætiology of hyperpiesis. Repeated examinations of the blood-pressures in ex-soldiers suffering from chronic anxiety conditions have convinced me that high systolic and diastolic readings are almost invariably found, more or less in proportion to the degree of anxiety present.

Two more points before conclusion. The series I showed in Table II demonstrated the frequency with which a family history of " arterio-sclerosis," " apoplexy," or " blood-pressure " is obtained. A family history of characteristic vascular lesions occurred in no less than eight of the series. The patient in Case III of the series was the son of a father who died of cerebral hæmorrhage at 60 years of age. He had a brother living who suffered from " blood-pressure." A sister resided at a spa and was a sufferer from " paralysis " of one side, while another sister appeared to have had a stroke—after the birth of a child—from which she ultimately died.

The other point deals with the influence of climate. In my series, five patients had lived for years in tropical or subtropical climates. This large number is probably quite accidental. But a letter from the Bishop of Singapore has recently appeared in a medical journal [22] in which he describes many of the early symptoms of cerebral arterio-sclerosis as commonly occurring in Europeans residing in the tropics, and asks for an explanation. Among the symptoms he gives are irritability, dullness, partial loss of memory, depression, and even suicide. These disturbances, often accompanied by headache, suggest an early cerebral arterio-sclerosis.

Since the letter appeared, the high incidence of oriental residents in the twenty cases quoted has assumed an added importance.

Conclusion.

This brief sketch of cerebral arterio-sclerosis will, it is hoped, promote discussion. No new conclusions can be drawn from the cases with which the subject has been illustrated. The occurrence of depression and confusion in men especially, in the late forties, early fifties, or sixties, should always raise the question of a sclerosis which may be confined to the cerebral vessels.

It is more than probable that many of the presenile insanities are based upon cerebral arterio-sclerosis with or without hyperpiesis. In a detailed examination of such patients, a careful history and routine ophthalmoscopic examinations may enable a secure diagnosis to be made at an early stage in the disorder. The treatment of the condition cannot here be discussed. As in other branches of medicine, the earlier treatment is applied the more successful are the results.

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Discussion.—Dr. C. C. WORSTER-DROUGHT said that Dr. James had left little to be said. One point needed emphasis: this was the reluctance of many practitioners to diagnose cerebral arterio-sclerosis in the presence of a low blood-pressure. It could not be sufficiently insisted upon that the state of the palpable arteries was not necessarily a criterion of the condition of the cerebral arteries, nor indeed was the blood-pressure reading. This was well illustrated by a case recently under the speaker's care. The patient, aged 64, was admitted to hospital as a possible case of encephalitis lethargica. He was somewhat drowsy and confused; speech slurred; pupils irregular, but reacting to light; no other very definite physical signs. His blood-pressure was only 130 mm. systolic, 78 diastolic, and the accessible arteries—radial, brachial, dorsalis pedis, &c.—were not unduly thickened, yet at the post-mortem examination all the main arteries of the brain and their branches showed very advanced nodular atheroma, as well as general diffuse sclerosis, with fairly widespread thrombosis. The coronary arteries were also atheromatous. Dr. James's description of the appearance of the retinal blood-vessels had been most interesting and the speaker thought every case of cerebral arterio-sclerosis would be found to show some degree of change in these vessels. He considered that the most significant sign, apart from symptoms of a focal lesion, was that afforded by the state of the retinal arteries.

He did not quite agree with Dr. James's opinion that the pupillary changes in cerebral arterio-sclerosis were a late manifestation. He himself frequently found an irregularity in outline of the pupils and a sluggish reaction to light in early examples of the disease seen in the out-patient department of a neurological hospital, and it was often a clinical problem to differentiate between cerebral arterio-sclerosis and early general paralysis of the insane. In many cases the diagnosis could only be determined by the results of the Wassermann reaction and other changes in the cerebro-spinal fluid and in the blood. His experience agreed with that of the reader of the paper in not having seen a complete Argyll-Robertson pupil in a case of cerebral arterio-sclerosis.

He was interested to hear Dr. James say that the transient palsies in the condition were due to minute hæmorrhages. In many cases they were believed to result from localized thrombosis. It had also been said by some that they were due to angiospasm—a claudication of the blood-vessels—in spite of the fact that physiologists taught us that vasoconstrictor fibres were absent, or at least at a minimum, in the cerebral vessels.

Dr. R. TRAVERS SMITH remarked on the difficulty of finding a satisfactory classification of arterio-sclerosis. He thought heredity was a common factor in cases of arterio-sclerosis; he could recall a family in which two brothers died of cerebral arterio-sclerosis. One of them showed no symptoms until he had a sudden, severe hæmorrhage, the other showed general mental failure four or five years before he had a cerebral hæmorrhage. A third brother had good health until he suffered from angina pectoris, from which he died, and at the autopsy an arterio-sclerotic lesion of the coronary arteries was found. He (Dr. Travers Smith) thought that the onset of cerebral arterio-sclerosis was largely determined and accentuated by hard mental work associated with anxiety and worry.

Dr. NEILL HOBHOUSE said he would be much interested to hear whether Dr. James had formed views in regard to the determination of psychotic symptoms. In general medicine one saw many cases of arterio-sclerosis, but only a certain percentage developed psychotic symptoms. Had that an anatomical reason to some extent, such as the anterior distribution of the arterio-sclerotic vessels, or was it due to an inherent psychopathic factor, or to the concomitant action of some toxin which brought about arterio-sclerosis?

With regard to decrescent cases associated with symptoms of rise of blood-pressure, he asked whether Dr. James had met with cases in which the onset of confusion was associated

with a fall of blood-pressure below that which was normal to the individual. He had seen a certain number of cases of people in middle life who had been under treatment for hyperpiesis and after that treatment had developed confusional states. Twice he had seen it follow severe epistaxis; and he had wondered whether too much success in lowering the blood-pressure was not attended by the danger of some such serious sequel taking place.

Dr. V. S. HODSON said he felt interested in this subject from the standpoint of those living in the tropics. He himself had lived in the tropics for many years and when he first went abroad he was told by an old resident that if he stayed in that country for ten years he would become either insane or indifferent. This statement was a way of stating a general belief. He believed that the physiology of the circulation was the real explanation. In this country one had to keep the body temperature up, whereas in the tropics the main idea was to keep it down, with the result that the circulation was more largely peripheral than in this country and so there was comparative cerebral starvation, with its accompaniment, a slowed and less effectual cerebration. This, when continued for many years, especially if, as was fairly common, there was some alcoholic indulgence, resulted in a man being unable to remember things or to make up his mind. The indecision of the tropics was well known. With regard to the question of the influence of occupation on the causation of the condition it was stated in an early edition of Osler's "Medicine" that the lumbermen of Canada were particularly liable to locomotor ataxy and that their work was as hard as any in the world. Shortly after he (the speaker) qualified he had a case of a miner who had ordinary locomotor ataxy, while his wife, a lace worker in Nottingham, had primary optic atrophy. In these two cases there seemed to be a definite association of the manifestation of the disease with the kind of work performed.

General paralysis of the insane affected chiefly, if not entirely, those whose preponderating effort was on the side of brain rather than of physical work.

A medical acquaintance who suffered from tabes dorsalis might be thought to be an exception, but he was in practice in the days when the rounds of a practice were done on horseback. With these effects of disease in mind it had been of particular interest to him (the speaker) to hear the statement that occupation had no influence on the question of the determination of arterio-sclerosis.

Dr. H. G. L. HAYNES said he did not gather whether the cases described and tabulated by Dr. James, had any other foci of arterio-sclerosis, and the author did not mention what proportion showed arterio-sclerosis of, for instance, the radial artery. He wondered if Dr. James had purposely excluded elderly patients from his case series, as none of those described by him were over 70 years of age. Many people over that age showed signs of mental trouble which probably had its origin in arterio-sclerosis.

Dr. GRAHAM FORBES asked whether any information of diagnostic value was to be obtained from an examination of the cerebro-spinal fluid in cases of arterio-sclerosis. He imagined there was very little value in it, except, perhaps, as showing an increase of protein. Such cases had occasionally been brought to his notice with the diagnosis of "arterio-sclerosis, query syphilitic," and when the cerebro-spinal fluid was examined the Wassermann and colloidal benzoin reactions and other tests gave no evidence of syphilis. That seemed the limit of information possible, but he wondered whether there was any change in the fluid to which one could attach importance in a case of uncomplicated cerebral arterio-sclerosis. He had been much interested in hearing of the possibility of confusion between the later stage of encephalitis lethargica and cerebral arterio-sclerosis, for in his limited experience the same difficulty had arisen from time to time, and examination of the cerebro-spinal fluid offered little or no help in distinguishing the two conditions.

Dr. A. A. W. PETRIE expressed agreement with the speaker who referred to the relation between the hardness of the artery and the blood-pressure. He had seen one or two cases in which the blood-pressure did not at all correspond with the feel of the arteries, and in such cases he had seen confusion. The cardiac type of case, in which there was a breakdown, showed a very distinct and fairly typical picture of confusion. In that connexion he wished to ask Dr. James about tinnitus and its relation to the pressure inside the vessel, the latter not corresponding with the condition of its coat; in other words, the pressure was sometimes low though the vessel wall was hard. An ear and nose surgeon, to whom he (the speaker) had sent cases, was convinced that the tinnitus could be greatly relieved by increasing the blood-pressure, and he (Dr. Petrie) thought there was something in that view. The only point to consider was whether one was justified in increasing the blood-pressure in that type of case,

thus getting rid of a comparatively minor ill, but possibly causing such a disturbance of the circulation that grave symptoms might ensue. He had no hesitation in interfering where there was an obvious breakdown of the cardiac part of the cardio-vascular system; it must be done to preserve life, and he believed it relieved the confusion. He also agreed, in some cases, to the small-hæmorrhage theory of confusion.

Dr. R. H. COLE (President) said he regretted that there was not a member of the Section of Ophthalmology present to give information about the retinal vessels in the condition under discussion, and as to whether in all cases of cerebral arterio-sclerosis there was involvement of vessels of the retina. Cases of general paralysis of the insane had been diagnosed very early by ophthalmologists, based on observations from the irregularity of the pupil. The practitioner had been advised to watch such patients, and in three or four years mental symptoms had developed. He (the speaker) did not know of cases of cerebral arterio-sclerosis having been thus first discovered by the ophthalmologist.

Dr. Haynes had pointed out that in senility the natural failure of metabolism affected the vessels, and might lead to death. Most of the cases described by Dr. James had been in the pre-senile stage.

With regard to the question whether there was cerebral arterio-sclerosis apart from general arterio-sclerosis, he (the President) confessed to still being sceptical. No difference might have been noticed in temporal and radial arteries, but had the aorta and other vessels always been carefully examined? To him it was difficult to conceive that such a disease should be limited to the cerebral vessels.

He agreed that nothing definite was known as to the causation of arterio-sclerosis. Many years ago, when playing golf with a distinguished surgeon, he noticed that that gentleman was "off his game," and the view he took of his own condition was that it was intermittent claudication of the vessels of the lower limb. Ultimately he died of that arterio-sclerosis. He was an inveterate cigarette smoker, and attributed his condition to that fact. Dr. Cole's own view was that tobacco was no more a cause of the disease than was alcohol. Abstemious people were among the victims of arterio-sclerosis.

Dr. JAMES (in reply) said that Dr. Worster-Drought laid stress on the extraordinary way in which, on occasion, as in one case (Case VIII) of this series, there was a normal blood-pressure, though the post-mortem examination showed a most advanced condition of cerebral arterio-sclerosis. That speaker differed as to the early pupillary changes. He (Dr. James) saw these cases mostly at a much later stage, and he was glad to have had a neurologist present to enter into this question of pupillary changes in the early stages of the disease. Mental hospital physicians saw these cases at a late period of the illness.

Angiospasm he regarded as a concept rather than a practical fact. The idea that transient aphasias and motor losses were due to local spasms of arteries seemed to him to be somewhat fantastic, especially as one could always find, when carefully searching for it, evidence of hæmorrhages in cases in which transient aphasias were common. But Sherrington did some remarkable experiments on arteries, showing conclusively that slight changes in temperature produced local spasm in the vessels.

Dr. Travers Smith wanted to dismiss the term arterio-sclerosis. He (the speaker), in writing this review, had dismissed the other terms which had been applied to the condition, retaining the name arterio-sclerosis, in which he included such terms as atheroma and athero-sclerosis. It was better to think of these conditions of arteries under one heading; there was a need for simplification of terminology.

Hyperpiesis and hyperpiesia had also been mentioned. The first of these was a term which expressed a condition of high blood-pressure due to renal or other cause; whereas hyperpiesia was a state of continued high pressure without any satisfactory explanation. Heredity, as Dr. Travers Smith said, was a very common factor, and Sir Clifford Allbutt and Sir William Osler both said the same thing, Osler declaring that the quality of the material in these families was defective. It was useful to conceive of every artery in the body receiving over a million blows or concussions, due to the pulsation of the blood, in twenty-four hours, and then to imagine the expression on the face of an engineer if he were asked to make a gun which would successfully discharge a million shells in twenty-four hours.

With regard to the psychotic factor, he (Dr. James) felt that this was largely determined by the personality of the patient. Most of the cases were depressive, but every now and then one encountered an elated arterio-sclerotic, resembling an elated paretic. None of this kind were included in his series, but he had come across them.

As to the result of too energetic treatment in hyperpiesis there was no doubt that a fall in the blood-pressure was sometimes accompanied by an attack of confusion ; the fall of pressure obtained as a result of energetic treatment was at times dangerous, and unexpected thrombosis in a cerebral vessel might follow.

Concerning the point raised as to the physiology of the circulation in the tropics, and the effect of occupation on the production of arterio-sclerosis, both arterio-sclerosis and general paralysis followed syphilis, and syphilitic cases were excluded from the paper. He thought that the forensic importance of arterio-sclerosis was not sufficiently recognized. This was a very real matter, because questions of responsibility might be largely involved. Often one found grave results follow a trivial injury in an arterio-sclerotic workman or ordinary member of society, which, in a robust person, would be successfully resisted.

He did not agree that arterio-sclerosis was a necessary accompaniment of old age ; he did not see why it should be. In doing the post-mortem examinations on the progressive cases he found there was a certain amount of sclerosis throughout the body, and it was especially marked in the coronary arteries. As he had said, fainting was a common event in the decrescent cases, in which the coronary arteries were frequently diseased.

The question raised by one speaker as to examination of the cerebro-spinal fluid was a very important one. In his own experience, such examination only furnished negative information. Clinically, there was often confusion as to diagnosis, and as a routine one did lumbar puncture. But the utmost value of that procedure was in enabling one to exclude syphilis ; it did not yield much *qua* arterio-sclerosis.

With regard to the point raised by Dr. Petrie as to tinnitus, in his own experience tinnitus occurred often, especially in hyperpietic cases ; it could be relieved under both conditions. If a hyperpietic complained of tinnitus, it could often be relieved by such drugs as nitro-glycerine ; whereas the tinnitus associated with low pressure might be relieved by raisig the blood-pressure, though he doubted the wisdom of attempting it, even were any satisfactory method known.

He wished—equally with the President—that a member of the Section of Ophthalmology had been present to discuss retinal changes in the disease ; but he had talked the matter over with several ophthalmologists and he had received with gratitude some interesting letters from them. Mr. Leslie Paton, for instance, was somewhat uncertain as to the value of retinal signs in the earliest stages of cerebral arterio-sclerosis, though he said that, later on, the arterial conditions of the retina were a direct index of the condition of the cerebral vessels. Mr. Affleck Greeves said he thought the most important sign in very early stages of arterio-sclerosis was a knuckling of the veins, such as the speaker had shown on the screen on the present occasion, and that reduction of the pressure to a reasonable level caused a disappearance of this knuckling. Mr. Chavasse was convinced that the earliest signs of retinal arterio-sclerosis were a close index of the state of the cerebral vessels, and that gentleman spoke of the knuckling of the vessels, and their deviation at crossings.

The President was sceptical about the cerebral circulation alone being affected by arterio-sclerosis, but he (the speaker) assured him that one patient (Case VIII of the series) who had epileptiform fits, showed no signs of arterio-sclerosis in his body, whereas the vessels of the brain showed a condition of advanced arterio-sclerosis, especially those in the circle of Willis. Here the vessels were so hard and tortuous that they were almost able to stand up unsupported.

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Section of Surgery.

President—Sir G. Lenthal Cheatle, K.C.B., C.V.O., F.R.C.S.

DISCUSSION ON "PRE-CANCEROUS STATES."

Dr. J. H. Sequeira.

I find it a little difficult to define exactly what is a "pre-cancerous" condition, although I think we are all aware of what is generally understood by that term. With regard to the skin, we encounter all degrees of susceptibility. At one end of the scale there are conditions which occasionally develop malignancy, and at the other we find congenital and acquired conditions which are peculiarly prone to become cancerous. There is some support for the opinion that certain affections of the skin and adjacent mucous membranes inevitably become malignant, that is to say, that they are potential cancers *ab initio*, and I well remember that my old teacher, Sir Frederick Treves, was accustomed to say when demonstrating a case of leukoplakia of the tongue, "This condition will become cancer if the patient *lives long enough*."

For convenience I classify the skin affections predisposing to cancer as follows:—

(1) *Congenital Anomalies.*—(*a*) Nævi—pigmented moles, warty nævi, including tylosis. (*b*) Xerodermia pigmentosa.

(2) *Senile Changes.*—Biotripsis, senile keratoma.

(3) *Local Irritation.*—(*a*) Trauma. (*b*) Exposure, the seaman's skin and allied conditions. (*c*) Heat, kangri cancer, &c. (*d*) Actinic light. (*e*) X-rays. (*f*) Chemicals—occupational cancers due to tar and its derivatives, paraffin, soot, arsenic.

(4) *Scars.*—Cicatrices of lupus vulgaris, lupus erythematosus, syphilis, burns, &c.

(5) *Chronic Dermatoses* (apart from cicatrization).—Lupus vulgaris, lupus erythematosus, psoriasis.

(6) "*Bowen's Dermatosis.*"

(7) *Paget's Disease.*—Mammary and extra-mammary.

These may be considered in groups, and to save the time of the meeting I propose to illustrate the types as far as possible on the screen.

Nævi.—Pigmented moles (nævi pigmentosi) are very common cutaneous developmental anomalies. That they occasionally develop nævo-carcinoma of melanotic type with rapid metastasis is well known, but in my own experience such a contingency is rare. Warty nævi of unilateral type (nævus unius lateris) occasionally develop malignancy, the growths being squamous carcinomata. I have had one case in which tylosis, congenital hyperkeratosis of the palms and soles, became cancerous, the tumours being of the squamous type. In this man the tylosis was familial, and his two children were under my care for the same condition.

In connexion with the congenital anomalies, I must mention Dr. Adamson's suggestion that basal-celled carcinomata (rodent ulcer) begin in developmental anomalies of the glandular elements of the skin. He points out that rodent ulcers of the face develop in exactly the same areas as the multiple benign epitheliomata of Brooke, and clinically there is a great resemblance between this condition and some cases of multiple rodent ulcer.

Xerodermia pigmentosa is usually congenital. It may be described as a premature senility of the skin. The areas exposed to light become freckled, telangiectatic and develop numerous warty tumours. Many of these growths fall spontaneously, leaving atrophic cicatrices. From time to time, however, one or

more of the tumours become squamous carcinoma. I give in illustration the case of a little girl from whom many cancers were removed over a period of years, and also a case in which the disease was acquired. In the latter case, the patient, a young agricultural labourer, showed all the characters of the congenital affection, and numerous squamous carcinomata were removed by operation.

Biotripsis.—This convenient term, which we owe to the President of the Section (Sir G. Lenthal Cheatle), is a senile atrophy, although it is not present in all elderly subjects, nor is it confined to the aged. On the atrophic, often pigmented, skin flat papules appear, and many of these become covered with horny scales—keratomata. These lesions are most common on the face, ears, and backs of the hands. Both basal-celled carcinomata and cancers of the squamous type may develop in these warty excrescences.

The seaman's skin, like that of others exposed for long periods to wind and weather, is similarly liable to keratotic growths with a tendency to malignancy.

Actinic light is held by many authorities to be responsible for a similar condition. Norman Paul, of Sydney, finds that cutaneous cancers, which are particularly common in Australia, arise usually on keratoses produced by the actinic rays of the sun. I have seen numerous instances supporting this contention, though in twenty-five years' experience of light-therapy I have never met with a carcinoma developing upon areas treated over long periods by actinic light.

X-rays.—The changes produced in the skin by repeated exposures to the X-rays are almost identical with those occurring in xerodermia pigmentosa. Pigmentation, cutaneous atrophy, telangiectases and the development of warty excrescences which frequently become malignant, are demonstrated in the illustrations shown on the screen. These deplorable results of the over-treatment of lupus vulgaris, cheloids, psoriasis and other chronic dermatoses by the X-rays, and the terrible experiences of the early radiographers, are familiar to us all.

Chemical Irritants.—Tar and its derivatives, creasote, anthracene, &c., produce conditions resembling in many respects the X-rayed skin. After many years of exposure it is common to find the exposed areas pigmented and with numerous small cicatrices, from which small warty tumours (tar molluscum) have fallen or been removed. The tar worker does not as a rule worry about these warts. He applies caustic soda and the tumour disappears. But as years advance the tumours appear with increasing rapidity and develop into cancers, which are illustrated in the photographs shown. Dr. O'Donovan has found that the early wart presents the histological picture of squamous carcinoma. The tar cancers are found on the face, the forearm, the hand, and the scrotum.

What has been said of tar applies to creasote, to the workers who extract paraffin from shale and to the chimney-sweep, but in the latter the scrotum only is involved in most cases.

Mule-spinners' cancer affects the scrotal region, and has attracted much attention of late years. Here the irritant is mineral oil worked into the skin by the repeated impact of the "mule."

Arsenical cancer is not common. Prolonged administration of the drug, as in psoriasis, causes hyperkeratosis of the palms, and may be followed, as pointed out first by Hutchinson, by squamous carcinoma. Occupational arsenic cancer has usually been seen in the makers of sheep-dip, and here the question arises as to whether the malignant change is the result of local irritation or of absorption.

It is interesting to note here, as pointed out by Legge, that repeated irritation of the skin by chrome compounds is not followed by cancer. Tar and its allies, paraffin, soot and arsenic, appear to produce specific changes in the skin tending to malignancy.

Scars.—Cicatricial lupus vulgaris predisposes to the development of cancer, apart from X-ray treatment. In my experience the growth is always of the squamous type. It may take the form of a fungating tumour, or of a rapidly destructive ulcer.

I have had two cases of cancer developing on lupus erythematosus scars, and have seen instances of a similar malignant development in the cicatrices of syphilitic ulcers. I have not seen a cancer develop on a primary chancre, though such have been described. The scars of burns, varicose ulcers, cellulitis, &c., may also become malignant. In every case which I have had examined the growth has been of the squamous type.

Psoriasis, &c.—Whitfield and Gray have described cases of rodent ulcer developing on psoriasis, but it must be remembered that in most cases of old psoriasis there has been prolonged treatment by arsenic, and this may be a factor in the malignant development.

Multiple superficial carcinomata are not infrequent. The majority of the cases are of the basal-celled variety, the lesions having the character of the superficial cicatrizing rodent ulcer. There is, however, a type which some authors have called "Pagetoid," from a superficial resemblance to Paget's disease of the nipple, but this is distinguished by a narrow, raised, smooth margin, as shown in the water-colour drawing exhibited. A type occurring on the face in young subjects, closely simulating lupus erythematosus, has been recently demonstrated by Dr. O'Donovan. In this the lesions are squamous carcinomata, with a very low malignancy. Here, again, a cancerous development on lupus erythematosus might be suggested, but careful examination has shown that the lesions are malignant *ab initio*.

Bowen's dermatosis demands attention. Bowen described a pre-cancerous dermatosis, occurring in late adult life, characterized by chronic papular lesions covered with a horny crust. These spread and form nodular swellings which may become grouped or confluent. Under the crust is a red, oozing, slightly papillomatous surface. Cancerous degeneration has been observed by Bowen and Darier.

Paget's disease may affect other parts than the nipple. I have seen it on the glans penis and about the umbilicus. I look upon it as malignant *ab initio*.

[The address was illustrated by numerous photographs and water-colour drawings, which included representations of cases of cancer following irritation by a wedding-ring, the repeated application of heat in the case of a baker, &c.]

Sir G. Lenthal Cheatle (President).

The Pre-carcinomatous State in the Breast.

There is a sequence of the events concerned in epithelial hyperplasia of the breast, and it corresponds exactly to the sequence of events observed in the skin of mice and men after the application of tar.

I believe that the forms of epithelial hyperplasia of the breast are either directly or indirectly concerned in the carcinoma problem, but I also believe there is only one of them that can be described as the actual pre-cancerous state. Changes that occur before the latter certainly lead up to it, and all of them, so far as concerns tissue, are distantly connected with the pre-cancerous and carcinomatous states.

The states preceding the pre-cancerous state are two types of desquamative hyperplasia, one of which is far more important than the other. The first and less important type is a generalized collection in terminal ducts and acini of small desiccated, irregularly-shaped, badly-staining cells. It may exist for years in the breast, it causes continuous pain, and cysts rarely, if at all, develop from this form. This type sometimes occurs in ordinary fibro-adenomata that do not arise from the intra-elastica.

The second, and by far the more important type of desquamative epithelial hyperplasia, also affects the terminal ducts and acini, but is never so generalized as the first type I have described. The epithelial cells lining the terminal ducts and acini become elongated and feathery in appearance—a process which, in the ducts, leads to a collection of colostrum-like cells that can be seen arising in all stages of formation

from the feathery cells of the ducts. When larger ducts are implicated, then the colostrum-like cells form in the duct epithelium which does not here become elongated or feathery in appearance. This second type of desquamative epithelial hyperplasia is the great factor in the formation of duct and acinous cysts.

A more important type of epithelial hyperplasia that is not desquamative occurs; to distinguish it from the desquamative type, I term it dysgenetic epithelial hyperplasia.

Dysgenetic epithelial hyperplasia also affects the terminal ducts and acini. In the ducts and acini the epithelial hyperplasia may be papillomatous, sessile (that is to say, without any fibrous tissue elements), or a mixture of the two. In the acini, the acinous papillomata possess very fine fibrillous stalks. The individual cells in dysgenetic epithelial hyperplasia may be present without marked signs of active division; their nuclei, size and shape are fairly regular. On the other hand, their shapes may be irregular, mitoses frequent, and marked nuclear hyperchromatosis may be present. Although all the last three cell changes may be seen in ducts and acini that are completely or partially filled by the actively dividing cells, yet all of them are contained within normal boundaries. I regard this stage as malignant and pre-carcinomatous; it cannot be said to be carcinoma, because there is no invasion of outside tissues. This pre-carcinomatous stage may, I believe, atrophy and disappear, but if it progresses it becomes part of the process of carcinoma, and can be observed in the centre of epithelial cells which have invaded the connective tissue. Hence, although it is impossible to describe a state of dysgenetic epithelial hyperplasia that must inevitably end in carcinoma, it is possible to describe one which, should it progress, must inevitably end in carcinoma. That is as near as one can get to undoubted carcinoma.

Mr. W. Sampson Handley

said that in considering the pre-cancerous condition attention must not be focused exclusively upon the epithelial changes. The work of Bonney had shown that carcinoma was always preceded by long-standing, chronic, inflammatory changes in the immediately subjacent connective tissue, where collections of lymphocytes and plasma cells were invariably found. The lapse of time between the onset of these changes and the development of a cancer was a long one, and might roughly be stated as being from twenty to thirty years in those forms of cancer—such as lupus carcinoma, tar carcinoma, and carcinoma of the tongue following syphilis—where it was possible to estimate it with some approach to accuracy.

Breast cancer appeared to be no exception to the rule that carcinoma was preceded by a chronic inflammation of the connective tissue. In his (the speaker's) opinion these changes were conveniently and rightly described under the name of chronic mastitis. It was significant that both cancer and chronic mastitis showed a strong preference for the same region of the breast, namely, the upper and outer quadrant. Simple hypertrophic mastitis and early carcinoma with infiltration might often be seen in the same microscopic field. He (the speaker) acknowledged as fully as anyone the importance of the President's admirable work on the epithelial changes which preceded cancer of the breast, but those changes only constituted one chapter of the story. An equally important and earlier chapter related to the precursory changes in the connective tissue.

He (Mr. Handley) desired to draw particular attention to a factor which was very frequent, and perhaps constant, in the ætiology of carcinoma, namely, the pre-existence of chronic lymphatic obstruction in the region where the carcinoma began. This factor was certainly constant in lupus carcinoma, for lupus was essentially a destructive tuberculous lymphangitis. Syphilis, too, so often a precursor of mouth cancer, was essentially an infection of the lymphatic system and a cause of lymphatic

obstruction. Chronic mastitis, again, was probably a chronic lymphangitis arising from nipple infections.

A most striking case, illustrating the predisposing rôle of lymphatic obstruction, came under his notice some years ago. A lady who had lived in India many years came home with typical elephantiasis of one leg. She was persuaded by a friend to try radiant heat baths for the leg, and shortly afterwards virulent multiple epitheliomata, twenty or thirty in number, appeared on the skin of the affected leg.

It was an interesting point as to how lymphatic obstruction predisposed to cancer. It appeared likely that the rise in lymph-pressure led to an over-nutrition and consequent proliferation of the connective tissue; in this way were produced the pre-cancerous subepithelial changes which Bonney found so constant.

It was a striking feature of the histology of cancer that carcinoma cells could not maintain their vigour for very long if cut off from immediate contact with connective-tissue cells. The same thing was true of normal epithelium. The surface layers of transitional and pavement epithelium were constantly dying and being cast off. Then, too, it was known that epithelium could not live in the blood-stream. Considering these facts, he was led, years ago, to the conclusion that epithelium could not nourish itself directly from the fluids of the body, but that its food must be prepared for it and transmitted to it by a contiguous connective-tissue cell. In other words, the epithelial cell was an obligate parasite upon the connective-tissue cell. This conclusion had lately received direct confirmation from the work of Carrel upon tissue cultures *in vitro*. Carrel found that epithelial cells would only grow properly and develop normally when connective-tissue cells were grown along with them. It was obvious, then, how subepithelial collections of inflammatory cells might supply a morbid stimulus to the growth of the overlying epithelium.

It was also clear that lymphatic obstruction must lead to auto-intoxication of the cells through the agency of their own waste-products, a possible source of the "intrinsic" or chemical factor of Gye. There was here a direct suggestion for experiment. Was the filter-passing organism of Gye and Barnard able by itself, and without the introduction of any chemical factor from outside, to induce cancer in a region where lymphatic obstruction had been experimentally produced?

To sum up, clinical and histological observations indicated three outstanding factors in the causation of cancer: (1) Chronic irritation, either bacterial, thermal or chemical; (2) lymphatic obstruction; and (3) an acid reaction of the tissues. Time forbade the consideration of the third factor. The first might act partly or wholly by intensifying lymph stasis. The importance of the lymphatic system in pathology was only now beginning to be guessed at. If his (the speaker's) conclusion as to the part played by lymph stasis in the production of cancer were correct, it was obvious that further researches on lymphatic physiology and on the means for maintaining a vigorous lymphatic circulation might produce valuable results in the prevention of cancer.

Mr. Zachary Cope.

Pre-cancerous Conditions of the Alimentary Tract.

For practical purposes the term "pre-cancerous" can only refer to clinical conditions recognized by the naked eye. The pathologist may frequently detect changes in the cells which he considers pre-cancerous, but unless there is some clinical indication of an abnormal condition associated with such change, no cases will reach the pathologist, except accidentally. Of the clinical conditions in the alimentary tracts which may fairly be regarded, or propounded, as pre-cancerous, one must only select those for which a fair amount of evidence is forthcoming. First, in the tongue there are three conditions of a suspicious nature. Chronic superficial glossitis, with its attendant leukoplakia, is a frequent forerunner of cancer,

and if serious fissures exist in the tongue, or if leukoplakic patches persist in spite of adequate treatment, then the affected epithelium should be excised. Papillomata of the tongue can never be acquitted of malignancy until they have been excised and submitted to the microscope. One can never tell the moment at which such a papilloma will become malign. One is sometimes surprised to find malignant changes in some apparently simple cases. Thirdly, dental ulcers at the margin of the tongue must always be regarded with suspicion, treated with care, and watched assiduously; for it is possible that epithelioma may arise on them, and many patients attribute a cancerous ulcer to the irritation of the teeth.

There are no recognizable pre-cancerous conditions of the œsophagus, but, in the stomach, simple ulcer is asserted by many to be a frequent precursor of malignant disease. Very extensive investigations have been carried out by many well-known pathologists, who have arrived at diametrically opposed opinions. There is a similar division of opinion amongst the clinicians, and on this account there is room for a thorough combined investigation by both clinicians and pathologists on a very large scale. It is very likely that cancer can, and does occasionally, become grafted on to a simple ulcer, but this occurrence is probably much less frequent than current teaching by leading authorities would lead us to believe. One seldom hears of cancer arising in a stomach which has been affected some years previously by perforation of the simple ulcer. Perforated gastric ulcers are common. Cancer of the stomach is common. If simple ulcers were frequently followed by cancer one would certainly expect to hear more frequently of cancer developing in a patient who had previously had a perforated ulcer.

Cancer of the small intestine is very rare. It may be of the ring type or of the papillary type. Every papilloma of the small gut must be regarded as a pre-cancerous condition, and it is probably wiser to resect any coil of gut containing a papilloma rather than to remove the papilloma by enterotomy only.

An instructive case is that of a young man who had recurring intussusception of the small intestine due to papillomata. All the papillomata that could be felt by palpating the intestine were removed at the second operation, but in spite of that, intussusception due to recurrent papillomata recurred; the whole mass of affected gut was resected two years ago, and since then the patient has remained well. The specimen is shown as an example of papillomata of an undoubted pre-cancerous nature, for the rapidity of growth of the small tumours, impalpable at the second operation, is surely proof of their being on the verge of malignancy.

Similar tumours sometimes occur throughout the course of the large intestine, where excision is neither so easy nor so safe. In the large bowel, ulcerative processes are not uncommon in dysentery and other forms of colitis. Have we any evidence that such ulceration is followed by malignancy? Probably not. Stricture and pericolitis may follow from this or as the result of diverticulitis, but cancer rarely follows these conditions.

Finally, are we to accept the view that the stagnation of the bowel-contents due to kinks of various natures predisposes to cancer? It may be so, but there is little evidence sufficient to convince anyone who comes to the subject with a mind untrammelled by any definite convictions on the subject.

Dr. Ernest H. Shaw.

A study of the microscopic appearances of diseased tissues leads me to the belief that what are termed "pre-cancerous states" do really exist. For the purpose of this discussion I think it will be sufficient to consider two main conditions, in order to obtain the simplest view of the pre-cancerous state. These two conditions are:—

(1) Chronic inflammation.
(2) Simple new growths.

(1) *Chronic Inflammation.*—As concrete examples of this class, I propose to examine and comment upon the changes that are found in :—

(*a*) The breast.
(*b*) The cervix.
(*c*) The tongue and cheeks.

(*a*) The microscopic appearances of the breast tissues affected by chronic inflammation are numerous and varied. Some of these alterations of the normal structures are of great importance, and serve as a valuable guide to us in our efforts to form an opinion as to their significance in relation to carcinoma. The changes outlined below are very striking and, in view of the fact that definite carcinoma is found with them in many cases, one is forced to conclude that these inflammatory changes must play an important part in the ætiology of cancer.

In a breast affected with chronic inflammation the epithelium of the acini undergoes various alterations in form and arrangement. The cells enlarge and multiply. They are distributed in various ways, i.e., some are arranged as rings in dilated acini, others form solid masses filling the acini. Rings of tall columnar cells line the inner surface of cystic acini. In the last-named the cells may project into the cystic acini as tiny tufts, or even form papillomata.

On close inspection, it will be found that a thin band of fibrous tissue encloses the gland cells, and the latter are attached to it. This band, or basement membrane, serves as a very important guide to the pathologist in enabling him to form an opinion as to whether a given case is simply inflammatory in nature or whether carcinoma has developed. In certain cases it will be found that—perhaps in one small area only—this smooth, regular band or limiting membrane is absent, and that the clumps of cells are lying loosely in cavities and not attached to the walls. This difference in the relationship of the cells to the walls constitutes a vital point in our conception of the real nature of such cases. So long as the cells are attached to the smooth, encircling membrane the condition is simple, but when some groups of cells are discovered lying loosely in cavities, then the border line has been crossed and carcinoma is present. The cells have burst through the basement membrane into the surrounding lymphatic spaces and are free to wander further afield in the lymph-stream.

In all specimens of carcinoma of the breast coincident inflammatory changes are present, but in such examples as I have endeavoured to outline above, in which the main part of the sections consists of inflammatory tissues and only a small part is carcinomatous, it appears to me quite evident that inflammation has preceded the new growth. This points clearly to the great probability that in many instances a breast affected with chronic inflammation is in a pre-cancerous state, and in my opinion, there is no doubt whatever that this view is correct.

(2) *Simple New Growths.*—In many specimens of papilloma of the skin it is very difficult to determine whether the border line has been crossed and carcinoma has developed. Groups of squamous cells are found at the base lying in masses of small round inflammatory cells. In other cases groups of squamous cells are seen definitely invading the deeper tissues, thus proving the presence of carcinoma, and also showing that carcinoma is commencing in an innocent tumour. There can be no doubt, therefore, that on such evidence many papillomata of the skin are in a pre-cancerous stage. The same conditions occur in papillomata in other regions, such as the mouth, nose, larynx, intestines, &c.

Section of Surgery.

SUB-SECTION OF PROCTOLOGY.

President—Mr. G. GREY TURNER, M.S.

Simple Tumours of the Large Intestine and their Relation to Cancer.

By CUTHBERT DUKES, M.D.

(ABSTRACT.)

[Dr. DUKES said he would report research work carried out at St. Mark's Hospital during the last two years which was designed to throw further light on the relation between simple and malignant tumours of the intestine. The main conclusions to which this work had led were as follows:—

The cancer-producing agent, when it first affects the bowel, influences in the first place a large area of the bowel wall, and it may produce changes in the mucous membrane visible by the microscope before any changes can be detected by the naked eye. The first indication of the action of the carcinogenic agent visible to the naked eye is the appearance of a crop of simple tumours scattered over a relatively wide area of the mucous membrane. In one or more of these a true cancer may develop. After the cancer is well established some of the surrounding simple tumours disappear but others remain as a witness to the extensive area first affected.

Dr. DUKES led up to these conclusions by giving a detailed account of the development and architecture of simple adenomata or papillomata of the bowel, illustrating his remarks by several photographs and diagrams.]

These little tumours arise from small areas of increased epithelial activity, which can be distinguished under the microscope by the fact that the epithelial cells secrete less mucus than their neighbours and stain more deeply with hæmatoxylin. At a later stage the muscularis mucosæ is bent convex to the lumen of the bowel and a pedicle begins to form. The photographs of macroscopic and microscope preparations which are shown were obtained chiefly from cases of multiple adenomatosis, a disease which tends to affect several members of a family and is extremely likely to be followed by cancer of the bowel. In order to determine the frequency of simple tumours of the large intestine of people not suffering from cancer, 127 human intestines were examined and carefully searched from the cæcum to the sigmoid. In twelve cases an odd polyp was present. Simple tumours are, however, extremely frequently met with in the neighbourhood of a cancer of the large intestine. In the last thirty-three consecutive cases of cancer of the rectum at St. Mark's Hospital, I have found adenomata or papillomata around the cancer in twenty-five, or 75 per cent. These little tumours which accompany cancer can be demonstrated most clearly if the specimen be examined immediately it is removed from the body. The bowel should be washed with warm saline solution and pinned out flat. In large ulcerating cancers only an odd polyp may be found, but in early cases there is often a crop of a dozen small tumours on the two or three inches of bowel surrounding the cancer. These papillomata are much harder to find after the specimen has been placed in fixative solution because of the shrinkage forming folds which distort the natural appearance.

[Several photographs of sections through these tumours were then shown, and Dr. DUKES drew attention to four points brought to light during the study of the tumours. (1) The catarrhal condition of the mucous membrane round the neck of

a small pedunculated adenoma—"collar catarrh." (2) The retention of necrotic material in the sulcus round the neck of the tumour. (3) The fact that secondary tumours often developed round an isolated pedunculated adenoma, probably because of the irritation arising from constant friction. (4) The massive collections of lymphoid cells which are often found round the base of the tumours. The question as to whether these simple tumours preceded cancer or succeeded cancer could not be decided in every case.]

Evidence derived from the general structure of the tumours and from the physiological behaviour of the secreting cells suggests that in some cases the simple tumours are still growing up to the time the piece of bowel is removed by operation. In most cases, however, the tumours appear to be well established with well-formed vessels and are composed of cells, the majority of which secreted mucus. Probably some of these tumours preceded and some succeeded the cancer. The experience gained from a study of tar cancer in laboratory animals is of interest in this connexion. After painting the skin of laboratory animals with tar, tumour growth begins in isolated, usually minute, areas, and not diffusely through the whole zone of application of the tar. Often, after about three months' application of tar to the shaved skin of mice, a crop of little tumours arises on the painted surface. These usually vary from three to twenty in number: some remain small and others develop into pedunculated papillomata. Cancerous degeneration may overtake one or more of these experimental tumours usually about six to ten weeks after the scattered irregularities have been first noticed. After the cancer has first commenced the simple tumours usually progress no further.

We know very little of the appearance of the human bowel wall in cases of human intestinal cancer before the stage when a prominent tumour or ulcer has formed. But sometimes cancer is discovered by accident in a very early stage, and in almost all the reported cases such cancers have been found in what at first sight appeared to be simple tumours.

[Dr. DUKES showed several photographs of such early cancers, and in each case these were either multiple cancers with multiple adenomata or early cancers surrounded by simple papillomata. He thought that the evidence that he had collected justified the opinion (1) that the cancer-producing agent affected in the first place a very wide area of the bowel; (2) that, later, a crop of adenomata or papillomata arose in this sensitive field; and that (3) the changes we recognize as cancer usually appear first in one of these simple tumours, after which the neighbouring tumours cease to advance in size.]

Discussion.—Sir JOHN BLAND-SUTTON: When an organ of the body is the subject of intensive surgical study the result is invariably a great advance in pathological and clinical knowledge concerning it. This is true of malignant disease of the rectum and colon. Two instruments are responsible for this advance in knowledge—the microscope and the sigmoidoscope.

In 1881, Harrison Cripps gave a remarkable demonstration at the Pathological Society, of specimens illustrating the histology of malignant disease of the rectum.[1] Surgeons had been content to describe malignant tumours of the rectum as scirrhous cancers if they were hard; medullary if they were soft like marrow; and encephaloid if they resembled brain substance.

The specimens shown by Cripps were some of the most exquisite examples of histology I had seen, and they demonstrated the relationship of the cancerous mass to the glandular structures in the rectal mucous membrane. His main object was to ascertain if microscopic investigation of a rectal growth would reveal any constant feature by which a malignant tumour could be distinguished from an innocent tumour.

Cripps demonstrated that the rectal growths, commonly called cancers and polypi, contain glandular tissue; as a rule the microscope reveals appearances by which the innocent or the malignant nature of a tumour can be established; but there are examples which lack the distinctive features common to either of the pronounced types. From the histological stand-

[1] *Trans. Path. Soc. Lond.*, 1881, xxxii, pp. 87-112.

point I do not think any marked advance has been made. At the same time, no one can deny that since the invention of the sigmoidoscope our knowledge of rectal and colonic papillomas has been markedly increased. At the time Cripps published his observations, multiple colonic papillomas were a novelty and only recognized after death. When I arranged the specimens in the museum of the Middlesex Hospital, in 1883, examples of intestinal tumours were spoils from the dead-house; but when I rearranged them in 1923, the new specimens were prizes from the operating theatre.

My eyes were opened in 1900, when I operated on a woman, aged 41, for chronic intestinal obstruction, and felt a pedunculated tumour in the pelvic colon. This was exposed by slitting the gut. The tumour was cauliferous, the papillomas being as closely set as the bloom of a cauliflower. I excised it, and closed the bowel with sutures. Two years later the symptoms returned, and I resected the pelvic colon and left the patient with a colostomy. The piece of colon removed measured 8 in. and was stuffed with papillomas. She survived the operation eight years, and died in Germany. Her death was attributed to intestinal obstruction, probably cancerous.

Compound papillomas of this type are uncommon in the colon. When a carcinoma is found among a crop of papillomas in the intestine it is difficult to determine whether the cancer is primary or due to malignant change in a papilloma.

Proctologists are justified in claiming that the intensive study of growths in the rectum and pelvic colon demonstrates that the terminal sections of the big gut are liable, like other epithelial areas, to papillomas which may be solitary, multiple, compound or gregarious. They are common in adolescence; especially in the rectum. I believe they are rare in the cæcum and ascending colon. A single papilloma may drag on the mucous membrane and lead to intussusception. Gregarious and compound colonic papillomas induce intestinal obstruction. I do not know of any evidence that colonic papillomas, like laryngeal and cutaneous warts, disappear spontaneously.

Colonic and rectal papillomas are by no means restricted to youth, and cancer of the rectum is not a privilege of elders. I have seen it in a girl aged 16. Nevertheless, in relation to the rectum and contiguous sections of the colon, when clinical signs are not always sufficient to permit of a definite diagnosis, I believe this aphorism is applicable:—

Papillomas in adolescence,
Cancer in senescence.

The careful investigation submitted to the Sub-Section brings cancer of the colon and rectum into line in regard to the recognized pre-cancerous conditions of other organs, especially the breast and skin.

Dr. G. MARSHALL FINDLAY: Although little is known in regard to the ætiology of simple multiple tumours such as those of the intestine, it seems probable that chronic irritation plays a considerable part in their causation. Fibiger, in his experiments on feeding rats with spiroptera, found that both simple papillomata and carcinomata of the stomach were produced. In the same way in man, infection with *Schistosoma hæmatobium* not infrequently results in cancer of the bladder, while infection with *Schistosoma mansoni* is followed, in a high percentage of cases, by the appearance of simple papillomata of the rectum.

The difficulties of experimental investigation of simple tumours of the intestine are considerable, but in the case of other forms of papillomatosis there is evidence to suggest that a virus is of ætiological significance. It has long been known that multiple warts of the skin are infective and that a saline extract when passed through a Berkefeld filter still retains its infective power. The same is true of venereal warts, since a cell-free filtrate, when inoculated on the surface of the hand, is capable of giving rise to typical flattened warts. In the same way Ullman has shown that a Berkefeld filtrate of a saline extract from laryngeal papillomata will cause typical skin warts. Finally the diffuse papillomatosis of the mucous membrane of the mouths of dogs can also be transmitted by means of a cell-free filtrate.

Mr. P. LOCKHART-MUMMERY: I have for many years been persuaded that a very great proportion of malignant growths of the large bowel originate in a previously existing simple adenoma. I have several reasons for this belief. I have not infrequently actually seen the change take place. Thus, patients have come to me originally with a simple, innocent tumour of the rectum, and for some reason or another—age, inoperability or unwillingness to submit to operation—have not had the adenoma removed, and at a later date I have seen carcinoma supervene upon the previously innocent condition.

Further, in quite a number of cases one sees malignant growths of the bowel which are still, in part, simple adenomata. One must conclude that such cases are adenomata undergoing malignant change. Again, adenomata of the rectum, after removal, sometimes recur as cancer. If they are carefully looked for adenomata are so frequently found associated with malignant disease of the large bowel, that I am beginning to look upon a cancer of the bowel as an accident occurring to a previously existing simple adenoma. Indeed, I look upon all cases of simple adenomata of the large bowel in persons over 30 years of age as potentially

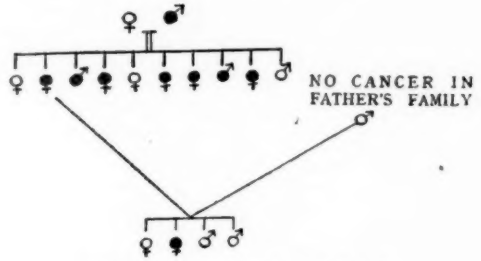

CHART I.—Family History of Case I.

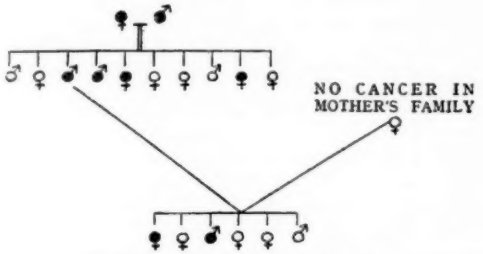

CHART II.—Family History of Case II

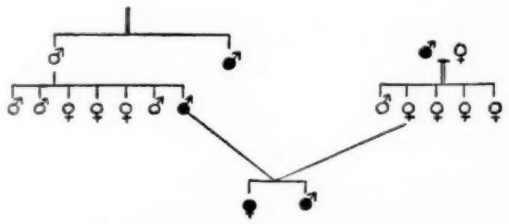

CHART III.—Family History of Case III.

The circles in black denote individuals who have either died of cancer of the large bowel or are known to be suffering from multiple adenomata of the colon and rectum.
It will be seen that in family No. 1 eight out of ten of the mother's family died from cancer of the bowel, and one daughter has been operated upon for multiple adenomata.

malignant tumours. They have to be removed locally, as one cannot perform so serious an operation as resection of the rectum for a simple tumour. But I always insist on a close watch being kept on such patients for at least another five or six years, and in almost every such case that I have seen a recurrence has occurred both locally and in other parts of the rectum, and in at least one case cancer has supervened.

The most striking instance, however, illustrating this association between innocent and malignant tumours of the bowel, is seen in those rather rare cases of multiple adenomata of the colon, or adenomatosis, as this disease is sometimes called. It appears to be a hereditary condition, as it can be traced through several generations, and the curious thing is that in such families a large proportion of individuals die at a comparatively early age from cancer of the bowel. It was this curious fact that induced me to suggest to Dr. Dukes that he should make a careful histological examination of adenomata with a view to discovering how they arose, and to see if he could study the transition stage between adenomata and carcinomata. We were fortunate enough at an early stage in the investigation to obtain a case of very early carcinoma of the rectum, the earliest I have ever seen; and Dr. Dukes, by patient investigation of a very large number of sections, has been studying the transition period between adenomata and carcinomata, and has been able this afternoon to demonstrate to you the stage of change from simple to malignant growth.

The charts exhibited (see p. 11) show the family history of three patients upon whom I operated in St. Mark's Hospital for multiple adenomata of the colon.

As you know, adenomata of the large bowel, apart from actual adenomatosis, are often multiple, and if, as we believe, cancer originates from an adenoma, cases of multiple cancer of the bowel should be seen. As a matter of fact such cases are not infrequently met with if carefully looked for. A specimen illustrating this condition, which I removed by abdomino-perineal resection, is exhibited this afternoon. It shows two cancers and two simple adenomata in the same portion of bowel. Experimental work on mice seems to prove that one carcinoma tends to prevent the growth of another in the same individual, and this may explain the comparative rarity of multiple malignant growth. When multiple growths do occur they are either exceptions to this rule, or more probably are due to two adenomata becoming malignant simultaneously.

I believe this investigation into the origin of simple adenomata, and, the changes which take place in them, is of the utmost importance in elucidating the cancer problem, and offers a simpler path to the investigation and origin of cancer than does the study of true cancers.

Section of Surgery.

President—Sir G. Lenthal Cheatle, K.C.B., C.V.O., F.R.C.S.

Sarcoma of the Femur, Spontaneous Fracture.

By J. E. Adams, M.S.

M. J., aged 25. Female. Single. Housekeeper. Previous health good, with the exception of tendency to dizziness and frequent nose bleeding. In January of this year the patient consulted her doctor for pain in the right knee and ankle, and was treated for rheumatism, without evidence of improvement.

On August 27, whilst walking, her right knee suddenly gave way and she fell down. She was unable to get up, and was taken to an infirmary, where she was treated for fracture of the femur. Apparently the bone was not X-rayed at the time. The method of treatment was not very creditable, but at the end of some two months the fracture had united sufficiently for the patient to walk with crutches. No weight could be borne on the leg, which was an inch and a half shorter than the left one, with considerable swelling a short distance above the knee-joint.

She was admitted to St. Thomas's Hospital on November 5. The knee was held in flexion at an angle of 150°. No further extension was possible, but flexion was very little impaired, though somewhat painful. The leg showed a more or less globular swelling, beginning two inches above the knee-joint and extending for five inches upwards. The skin over it was not reddened nor were its vessels enlarged, but there was marked tenderness on palpation. No pulsation and no egg-shell crackling could be detected, nor could enlarged glands in the groin be felt. No abnormal movement was felt in the neighbourhood of the tumour. Any attempt at manipulation caused pain, and the right leg was an inch and a half shorter than the left. The muscles were markedly wasted.

X-ray examination revealed an oblique fracture with considerable overlap, the upper end of the lower fragment being displaced upwards and outwards. There was some shadow about the fracture ends, but it had not the density of callus. The appearance was that of an imperfectly united fracture with malposition. Careful examination of the outline of the femoral shaft, some few inches above the fracture, showed loss of substance due to decalcification. There was no sign of inflammation or expansion of the bone.

This appearance, together with the history, was conclusive evidence of a pathological fracture. The absence of radial striæ in the radiogram did not rule out the possibility of an endosteal sarcoma, and a fact of importance was the tenderness of the femoral shaft above the swelling.

Radiograms of other bones were taken and both ischia showed similar areas of rarefaction, suggestive of secondary deposits.

For the purpose of a conclusive diagnosis an exploratory excision was made on November 19, and this revealed a greyish-white spherical growth invading the vasti, typical of sarcoma. Microscopy showed it to be of the spindle-celled type.

During the last three days a small nodule has appeared in the skin of the back, and, I think you will agree, this is probably a further secondary deposit.

A Case of Spindle-celled Sarcoma of the Left Femur treated by Radium and Amputation Distal to the Tumour.

By W. B. GABRIEL, M.S.

A. P., FEMALE, aged 53.

History.—Patient was admitted into the Cancer Wing of the Middlesex Hospital on April 30, 1924, with a spontaneous fracture of the left femur. On examination she was found to have 3 in. of shortening of the left leg, with obvious deformity at the junction of the upper and middle third of the left femur. No evidence of primary growth elsewhere was found ; a diagnosis of sarcoma was made.

Operation.—Performed on May 22, 1924. An incision 4 in. long was made over the antero-lateral aspect of the swelling, and a soft vascular tumour involving the bone was discovered. A portion was taken for section, and radium tubes were inserted.

Details of Radiation.—Four 50 mgm. and two 37 mgm. tubes of radium bromide with ½-mm. shields of platinum were buried in the substance of the tumour. The 50 mgm. tube and one 37 mgm. tube were kept in for twenty-two hours, the other 37 mgm. tube was kept in for twenty-six hours.

Subsequent History.—The patient was then admitted to a permanent bed, where her general condition steadily improved. Considerable œdema of the left leg gradually developed, and the deformity at the seat of the fracture became gradually more marked. X-rays finally showed union of the fracture, and no clinical evidence of growth was forthcoming.

Last Operation.—September 11, 1925. Amputation of left leg performed below the seat of fracture with the object of removing the leg, which was very œdematous and consequently useless. Patient made a good recovery and will be discharged capable of walking on crutches.

Section of the primary tumour proved it to be a spindle-celled sarcoma.

A Case of Paget's Disease.

By W. B. GABRIEL, M.S.

H. D., MALE, aged 58.

History.—Admitted to the Middlesex Hospital on December 21, 1924, with a recent transverse fracture of the left patella.

Operation.—December 31, fragments were sutured with two osseous sutures of No. 6 silk, and the capsule repaired. Patient made a good recovery. He now exhibits enlargement and anterior bowing of the left femur, great thickening of the clavicle and filling in of the temporal fossæ.

A Case of Chondroma of Chest Wall.

By W. B. GABRIEL, M.S.

J. S., MALE, aged 50.

History.—Admitted to the Middlesex Hospital on October 12, 1925, with a history of a lump on the right side of the chest of about twelve months' duration.

Examination showed a hard, fixed mass, about 4 in. in diameter, on the right side of the chest, involving the second and third ribs.

Operation.—By Mr. Webb Johnson, October 21.

An oblique incision was made over the tumour, which was then removed together with portions of the two ribs. On its deep aspect the pleura was very adherent, and in one place the lung was adherent and had to be separated by blunt dissection. The pectoralis major was sutured over the deficiency in the chest wall, and the skin repaired. Subsequently the patient developed a considerable degree of bronchitis, and surgical emphysema was noticed down the right arm as far as the elbow. The right lung, however, expanded very quickly.

Patient was allowed to get up three weeks after operation, and was discharged on November 25, 1925.

Section of the tumour showed it to be a chondroma, with no evidence of malignancy.

Ulcerating Carcinoma of the Breast treated by Radium.

By DUNCAN C. L. FITZWILLIAMS, C.M.G., F.R.C.S.

MRS. K. K., aged 46. Nine months ago patient noticed something the matter with her right breast. As her husband was suffering from burns at the time she did not like to trouble him. The doctor who had attended her husband ever since his accident was never told a word of her condition. Seven weeks ago the breast began to ulcerate ; the whole breast now forms a prominent red mass, with a circumference of 22½ in., vertical diameter 7 in., horizontal diameter 6½ in., elevation 3½ in. Its surface is cauliflower-like, and no epithelium is left ; there is very little pain in it. The glands in the axilla are enlarged and hard, but none are felt elsewhere. Her general health is good.

Fifteen needles with 2 mgm. of radium, and one tube of 45 mgm. of radium, have been inserted round about the growth for twenty-four hours.

Since the time of the application of radium her temperature has been slightly raised. It is intended to remove the mass, not with any idea of permanent cure, but in order to rid the patient of this huge ulcerous mass.

Sarcoma of Left Breast.

By DUNCAN C. L. FITZWILLIAMS, C.M.G., F.R.C.S.

MRS. H., aged 69. The patient just noticed a small lump in the breast about six months before admission. It grew larger and finally became discoloured, being of a purplish tinge and rather painful (fig. 1, p. 16).

On admission there was a large tumour on the left chest about 4 in. in diameter and hemispherical in shape. The tumour had pushed the main mass of breast tissue downwards and outwards, so that the nipple was almost in the axilla low down. It was quite hard in consistence and very vascular. There was no pulsation in it. It was fixed to the pectoral fascia (fig. 2).

June 24, 1925.—The tumour and breast were removed and the axilla dissected. No glands found. Pathological investigation showed the tumour to be a spindle-celled sarcoma (fig. 3).

The patient made an uneventful recovery.

Deep X-ray therapy has been applied at three-weekly intervals since her operation.

Postscript.—At the present date (May 29, 1926) she is free from any signs of recurrence.

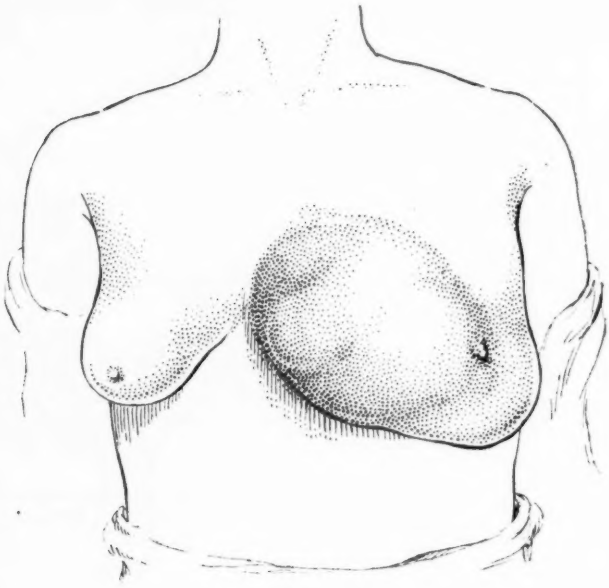

FIG. 1

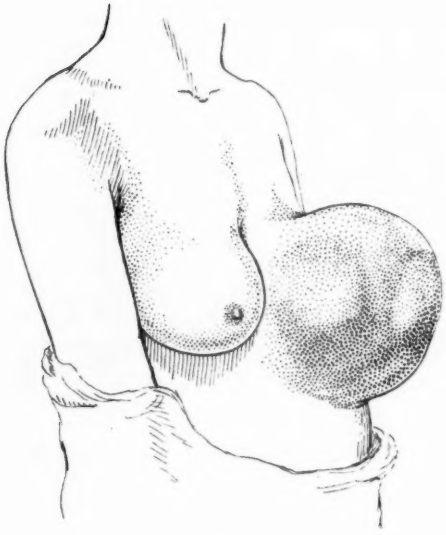

FIG. 2
Sarcoma of left breast.

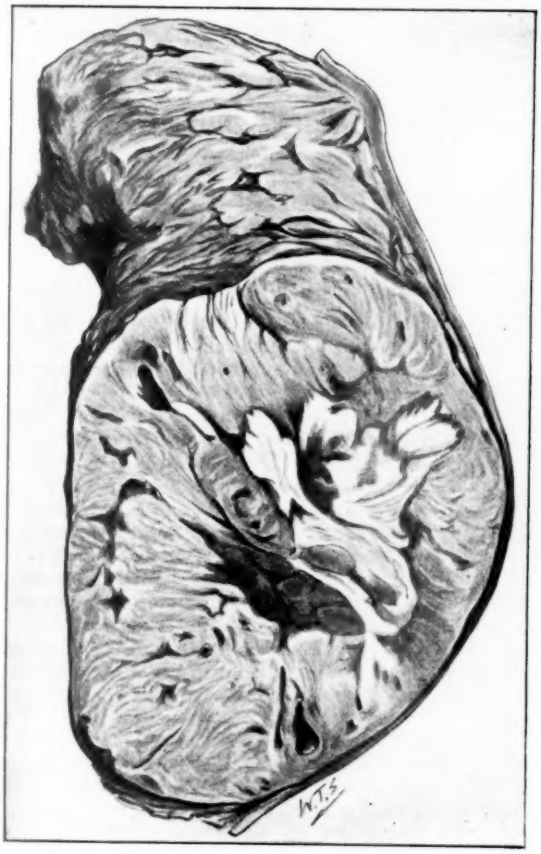

FIG. 3
Sarcoma of left breast.

A Left Inguinal Hernial Sac containing a Supernumerary Spleen.

By R. DAVIES-COLLEY, C.M.G., M.Ch.

THE specimen was removed from a man aged 40, who had suddenly developed a hernia during an athletic contest four years previously.

At the operation the hernial sac was found to be divided by a tight constriction into two portions, the upper of which contained a loop of gut, while the lower was occupied by the accessory spleen. The latter was suspended upon a fibrous cord, the lower end of which was inserted into the upper pole of the testis, while the upper portion traversed the entire length of the hernial sac and passed upwards through its neck into the abdomen towards the left kidney.

The specimen was sent from India by Major J. B. Hance, I.M.S.

DISCUSSION ON THE COMPLICATIONS OF EXCISION OF THE RECTUM.

Mr. J. P. LOCKHART-MUMMERY.

THE operations which are now performed for removing the rectum in cases of cancer of that organ are now fairly well established along stereotyped lines, and our experience of these operations has run into large numbers during the last ten years or so. It seems, therefore, that it can only be profitable to all of us to discuss the complications which are met with and the means which can be taken to prevent such complications, or to treat them when they have occurred. I do not propose to make any distinction between the abdomino-perineal and the perineal methods in discussing the complications, as they are the same for both operations, except that, of course, with the more serious operation of abdomino-perineal excision, the complications tend to be more frequent and more severe. One thing has been very noticeable during the last ten years in regard to operations for excision of the rectum, namely, that serious complications have become much less frequent. Some years ago constant attention and care were necessary, and a long and tedious convalescence was the rule; now these cases recover with the greatest regularity, and it is only in exceptional instances that complications of any serious consequence are met with. Although I shall enumerate a large number of complications, it must not be assumed that they are really at all frequent, for such is not the case.

I shall divide the complications into two classes: (1) *Immediate.* By which I mean those which tend to arise during the period of healing of the wound. (2) *Remote.* Meaning those which tend to occur as a result of the operation during the course of succeeding years (excluding, of course, recurrence).

I.—IMMEDIATE COMPLICATIONS.

These, roughly arranged in order of frequency, I shall classify as follows:—

(1) Sepsis.
(2) Shock.
(3) Hæmorrhage.
(4) Delayed healing.
(5) Orchitis and epididymitis.
(6) Intestinal obstruction.
(7) Urinary complications.
(8) Sloughing of the gut.
(9) Bronchitis and pneumonia.
(10) Pulmonary embolism.
(11) Hemiplegia.

(1) *Sepsis.*—This used to be by far the most serious and frequent complication, and at one time was almost the rule after such operations, but now sepsis of a serious character is quite the exception. There is, I think, hardly any operation in which it is so difficult to prevent sepsis as in excision of the rectum, and in men, at any rate, healing by granulation, which entails a certain amount of sepsis, must be the rule rather than the exception, as we have no satisfactory means at present of filling in the cavity left by the removal of the rectum. I have had several cases of primary union in men, but such cases are the exception (though

in women primary union is quite frequent), and more usually the wound has to heal by granulation. Nevertheless, it should do so without septic complications, if there is no primary infection, by which I mean infection at the time of the operation or immediately after it. Only the greatest care at the operation and during the first few days can prevent it. My own practice is not to drain the wound for the first three to four days, but to content myself by letting any accumulated blood or serum escape daily, when the wound is dressed, by inserting dressing forceps between the stitches, and at the end of three or four days removing a stitch and inserting a tube. I believe this to be a good plan, and that it helps to prevent infection during the critical period while the granulations are forming. When sepsis does occur, as it sometimes will in spite of the greatest care, the wound should be opened sufficiently to allow two large tubes to be inserted, and the cavity should be washed out three times daily, or more often, with Milton solution, 2 drachms to the pint. It is a bad plan to drain near the sacrum, and I prefer to keep the opening, when there is one, well down in the perineum, as such sinuses are more easily healed. If the wound completely breaks down (fortunately a very rare occurrence now), I think the best thing is to pack it with gauze, soaked in Milton or Dakin solution for two or three days, and then sew the wound up again with large mattress sutures.

(2) *Shock.*—This used to be a serious complication, but is seldom seen now, at any rate after the perineal operation, although it is still a danger after operation by the abdomino-perineal route. The risk of shock has been greatly reduced by using regional or spinal anæsthesia as the principal anæsthetic, and gas and oxygen, or "twilight sleep," as the general anæsthetic. The advantages of these methods of anæsthesia are, I think, nowhere so well seen as in cases of excision of the rectum. Personally, I never use ether or chloroform, except in an emergency, in such cases.

Another factor of great importance in avoiding shock after these operations is the preparation of the patient. It is now my practice in all hospital cases to keep the patient quietly in bed for at least a week, or sometimes a fortnight, before performing the operation. During this time the patient is fed up, and his reserve built up by means of strychnine and suitable tonics. We have found that this has made a great difference in the mortality after the operation, more particularly in hospital patients, who are seldom in such good condition as patients seen privately.

Another very important factor is to avoid purgation before operation, and not to starve the patients at all either before or after.

There are certain cases in which, on account of the position of the growth, anatomical peculiarities, or senile changes in the arteries and high blood-pressure, hæmorrhage during the operation is liable to be excessive. In such cases it is not always possible to avoid considerable loss of blood, and should this occur my practice is to get the patient transfused with human blood from a healthy individual as soon as possible after the operation. I am sure that this is a life-saving method, and I propose in future, when such a complication can be anticipated, as is, I think, often the case, to have a suitable donor in readiness.

(3) *Hæmorrhage.*—This is not very common, but must inevitably occur occasionally. In my last 100 cases I have not had a case of hæmorrhage which required packing or other interference, or which was followed by any serious results, but I attribute this to good fortune and feel sure that there is trouble in this direction in store. The only thing to do is to open up the wound and either secure the vessel causing the trouble, or else pack. The great danger is not that the hæmorrhage will be fatal, but that dangerous sepsis will result. There is no more potent cause of sepsis than hæmorrhage in the wound. Transfusion with blood from a suitable donor is the best treatment apart from stopping the bleeding. I have only met with one case of hæmophilia after excision, and am sorry to say that I lost the patient (a male) in spite of all that could be done.

(4) *Delayed Healing.*—This may be either due to the formation of a sinus at the

back which refuses to heal, or very occasionally, in old and senile persons, to inability to form fresh tissues.

Delayed healing of the sinus is not uncommon, and may be due to several causes. It may result from the presence of some foreign body such as a slough which is slow in separating, or a ligature. Other foreign bodies we will not mention, although they are the surgeon's nightmare! Personally, I never use anything but catgut in excision of the rectum, as silk ligatures may cause much trouble.

The commonest cause of slow healing is the formation of a bottle-shaped cavity with a narrow external opening, or a long crooked track running up towards the end of the blind bowel into which it opens. The sinuses give rise to no serious trouble, but occasionally they cause much inconvenience. They always heal eventually. If they refuse to heal after a reasonable time, they should be opened up and free drainage to the surface established. Mere scraping them out is of very little use. It is nearly always in men that the sinuses occur; in women the wound generally heals up very quickly and easily. I always get patients up and about as soon as possible, and find that this hastens healing. Premature removal of the drainage tube is a common cause of troublesome sinuses.

(5) *Orchitis and Epididymitis.*—In removing the rectum for carcinoma in men, it is often impossible to avoid injury to the vas or to the vesiculæ seminales. They may be involved in the growth and have to be removed. In such cases an acute or chronic inflammation of the testicle is liable to result and may be troublesome. Careful ligature of the vas at operation should prevent this, but it does not always do so. The use of peroxide of hydrogen for washing out the wound is, in my opinion, sometimes the cause of this complication.

(6) *Intestinal Obstruction.*—This is one of the serious complications of rectal excision and may occur in several ways. I have known all the following occur: (1) Small gut strangulated through a gap between two of the stitches closing the pelvic floor; (2) small gut adherent to the line of suture in the pelvic floor; (3) strangulation of small gut round the pelvic colon at the site of the colostomy; (4) strangulation due to adhesions to the abdominal incision. These complications are now very uncommon, and are only seen after performance of the abdomino-perineal excision.

Should evidence of obstruction occur the only treatment, of course, is to re-open the abdomen. Unfortunately the patient is seldom in good enough condition after an abdomino-perineal excision to stand another laparotomy, so that such a complication is very fatal. To my mind, the best way of obviating this complication, apart, of course, from very careful stitching of the pelvic floor, is to prevent the occurrence of vomiting after the operation. This is best secured by using only spinal or local anæsthesia and "twilight sleep," or gas and oxygen, and entirely avoiding chloroform and ether. It is generally the straining from vomiting that brings on strangulation. Should signs of obstruction arise, the first thing to do is to move the patient into a different position. For instance, turn him on his face, or considerably raise the foot of the bed, and at the same time give 1 c.c. of pituitary extract. I have known this relieve the condition, no doubt by the action of gravity drawing out the strangulated gut, or pulling it away from its attachments. If this fails, immediate operation affords the only chance of saving the patient's life, and it should, if possible, be performed under spinal and morphia anæsthesia.

(7) *Urinary Complications.*—It stands to reason that an operation which practically clears the posterior pelvis of its contents must result occasionally in causing some derangement of the urinary apparatus; indeed it is surprising that it does not invariably cause trouble.

Retention of the urine is usual; to get over this difficulty, and to assist one during the operation, a gum elastic catheter is tied into the bladder previous to operation and retained for three to four days. It is seldom that any trouble from

retention occurs after this. It is, however, most important that the patient should be carefully watched to see that the bladder is being properly emptied, or a cystitis is almost certain to result. The commonest form of urinary trouble is a coli-cystitis, often a recrudescence of a previously existing weakness.

A more serious complication is an urinary fistula from injury to the bladder. When this is found to have occurred a catheter should be tied in and retained until the fistula has healed, which it does quite readily.

In the early days of abdomino-perineal excision injury to the ureters (generally the left) sometimes occurred and this was a most serious complication. The fact that the patient voided urine by the urethra, as well as by the wound, proved the presence of an injury to the ureter. As the ureter is in such circumstances always cut low down in the pelvis it is generally useless to attempt repair of the damage unless it is detected at the time of operation, and the only thing to do is to remove the kidney on the affected side, after, of course, being most careful to check by suitable tests which ureter is the damaged one. An ascending pyelitis invariably follows such injuries to the ureter and for this reason removal of the kidney is the only thing to do. In one case which I saw in consultation it was advised to ligature the damaged ureter and so produce atrophy of the kidney. This was done, but the patient died of acute uræmia in two days. If the injury is detected at the operation transplantation of the ureter into the bladder is effective.

A rare complication which has occurred twice in my series is nocturnal incontinence. Both patients were men and both had control in the daytime, that is to say, while they were conscious, but complete loss of control occurred during sleep. Both were cases in which a fairly large growth had been removed from the upper part of the rectum. The first patient continued to have nocturnal incontinence for six months after operation and then obtained complete control. The operation was done six years ago and he has remained well since. The other patient had nocturnal incontinence for some six or seven weeks and then quite recovered and has remained well since—a period of four years.

I have twice had to operate upon patients who had previously undergone a prostatectomy, and in both instances I found that the operation was rendered very difficult. One patient developed an urinary fistula, but recovered. A previous prostatectomy is certainly a factor to be reckoned with in estimating the difficulties of the operation. How far a previous excision will complicate a subsequent prostatectomy is another story.

(8) *Sloughing of the Gut.*—This was a common complication and a very fatal one in the days when we used to bring down the pelvic colon and attempt to restore the rectum after an abdomino-perineal excision. It was because of that we abandoned this method in favour of a permanent colostomy. The truth is that the blood-supply of the lower part of the pelvic colon does not allow the gut to be transplanted with any degree of certainty, at any rate in elderly persons.

(9) *Bronchitis and Pneumonia.*—These are now rare complications after perineal excision, and our improved methods of anæsthesia have done much to do away with them as a serious menace to our patients. Operations involving opening the abdomen in elderly patients in this climate must always, however, involve a certain risk of lung trouble, and the fact that it is impossible for patients to sit up after a rectal excision renders the treatment of chest complaints most difficult if they occur during the convalescent period.

(10) *Pulmonary Embolism and Thrombosis.*—This complication has unfortunately become more frequent with our improved methods of anæsthesia, this being doubtless due to the fact that the patient remains in a more quiescent condition both during and immediately after operation. It is the old story that "what we gain on the swings we lose on the roundabouts." The only means of avoiding this complication that I know of consist in careful preparation of the patient before operation to improve the general circulation and care to see that the operating table is well padded

and the patient not placed in a position which tends to impede the circulation in the inferior vena cava.

(11) *Hemiplegia.*—There is always, one must presume, a slight risk when operating upon elderly persons that a cerebral hæmorrhage will coincide with the operation or convalescent period.

This occurred to me in one case. The patient had a high blood-pressure before operation, left the table in a quite satisfactory state, but three hours later was found to be suffering from hemiplegia and to be affected with loss of speech. I am glad to say she recovered, both from the operation and the cerebral hæmorrhage.

II.—Remote Complications.

(1) Narrowing of the colostomy opening.
(2) Ventral hernia.
(3) Sacral hernia.
(4) Prolapse from colostomy opening.
(5) Persistent pain in the perineal scar.
(6) Accumulation of material in the blind end of the gut after perineal resection.
(7) Enlarged prostate.
(8) Persistent diarrhœa.

(1) *Narrowing of the colostomy opening.*—This gave me much trouble at one period, when it was my custom to trim up a colostomy opening so that there was no protrusion of mucous membrane. The results as regards appearance were excellent, but in quite a number of cases I had to re-operate some years later for stricture of the opening. I do not now remove the projecting mucous membrane and this complication has not since occurred. It is, of course, a simple matter to put right when it occurs, but in my opinion it can usually be avoided.

(2) *Ventral hernia* should not occur if the patient is fitted with a proper belt and wears it. The only cases I have met with—and they have been very few—have been where the patient preferred to wear a flannel binder in spite of instructions.

(3) *Sacral hernia.*—This only occurs when, in addition to the coccyx, a portion of the sacrum has been removed in order to give extra room during removal of a difficult high growth. I have seen it three times. The new pelvic floor gets stretched, and the intestines push their way down and cause a bulging of the skin below the sacrum and between the buttocks. Nothing can be done beyond fitting a suitable surgical support to prevent the hernia from getting larger. I have one patient with this condition who, with a suitable support, is able to play golf.

(4) *Prolapse*, which used to be such a common complication of colostomy, is now so rare, since we have been using the hypogastric incision through the left rectus, that I have only seen it in one case out of over 200, and then it was due to a young woman discarding any support over the colostomy region while doing strenuous work. I should consider it an extremely rare complication after a modern colostomy operation. Should it occur, prompt replacement and a suitable support will put things right. If it becomes irreducible, resection is the only treatment.

(5) *Persistent pain in perineal scar.*—I have had three cases of severe and persistent pain in the perineal scar.

In all these cases the pain came on gradually about a year after operation. One of these cases proved to be a recurrence in the lumbar glands, but the other two were not recurrences. One was due to a very large stone impacted in the lower end of the right ureter, and the patient was cured by removal of the stone. The other was apparently due to a small nerve becoming caught in the scar tissue in front of the sacrum. The pain was very severe, and came on in paroxysms rendering the patient almost desperate. I could find absolutely no cause for it, and as a last resort I cut freely across the scar tissue just in front of the sacrum with a knife. This immediately got rid of the pain.

(6) *Accumulation of inspissated mucus* in the terminal end of the blind bowel after perineal excision occasionally causes discomfort, but this can be remedied by properly washing out the bowel from the colostomy.

(7) *Enlarged Prostate.*—In several cases I have known enlargement of the prostate cause trouble from patients in whom I have removed the rectum.

(8) *Persistent diarrhœa* is a most tiresome complication in a patient with a colostomy. It is generally due to colitis, and suitable careful dietary combined with rest and lavage will help considerably to overcome the difficulty.

In conclusion I would like to say that I think it is greatly to the credit of British surgery that in the last fifteen years or so we have so advanced the technique of excision of the rectum for cancer, that whereas it used to be one of the most dangerous of operations, it has passed out of that category, and is now one of the safest of major operations.

Sir CHARLES GORDON-WATSON, K.B.E., C.M.G.

said that for the purposes of this discussion he had analysed his cases of excision of the rectum for a period of five years before the war, a period which included all his pre-war cases of abdomino-perineal excision, and also his excisions performed since the war to the end of 1925.

He would now show on the screen two tables summarizing the complications of these excisions, (*a*) pre-war, and (*b*) post-war, in abdomino-perineal and perineal excisions respectively.

The pre-war cases included thirty-two abdomino-perineal and two perineal, and the post-war nine abdomino-perineal and seventy-three perineal—a fact which showed that since the war he had preferred the perineal operation whenever possible. In this connexion he would point out that when the pelvic mesocolon was long excisions of growths at, and just above, the recto-sigmoidal junction were often possible and could be carried out successfully from below.

OPERATIVE MORTALITY.

He would like to make a few observations on operative mortality, i.e., early fatal complications. Operative mortality in major operations, assuming all patients to be equal risks, varied directly with the skill and experience of the operator. The mortality of the abdomino-perineal operation had been steadily reduced in the hands of those who were constantly practising the operation, but if sporadic cases were collected from numerous operators who were not in constant practice with this class of work the mortality would be found to be appallingly high.

The mortality of the perineal operation had never been so high as that of the abdomino-perineal and was steadily becoming less in experienced hands.

COMPLICATIONS.

In excision of the rectum there were certain major complications which must be expected in a certain percentage of cases. The most serious of these—general peritonitis—could never be ruled out in the abdomino-perineal operation, though accumulated experience in focusing attention on technical details in the hands of men like Miles had reduced this to the lowest possible figure. He agreed with Mr. Miles on the great importance of using his powerful crushing forceps to prevent risks of contamination of peritoneum. The risk of general peritonitis in the perineal operation was very small.

Next to peritonitis in order of frequency came shock; this had been greatly reduced in recent years by improvement in the preparation of the patient and by the use of spinal anæsthesia and gas oxygen in both types of operation, but it still remained as a serious factor in the abdomino-perineal, though not in the perineal.

Pulmonary embolism might be regarded as an "act of God" and outside the control of the surgeon, but the fact remained that cases of excision of the rectum were not infrequently victims of this complication, as his tables showed.

Intestinal herniæ through the pelvic floor and round the colostomy loop claimed a certain number of victims, and he had had unpleasant experiences in this direction, as shown by his figures. Since he had adopted the inflated balloon for the perineal wound he had had no case of perineal hernia, and ever since he lost a case from hernia round the colostomy (abdomino-perineal) he had been careful to shut off this loophole in subsequent operations.

The most troublesome of all complications and the most frequent in both types of operation was infection of the urinary apparatus—cystitis and pyelitis. A very large percentage of cases suffered some degree of cystitis, and a small percentage developed pyelitis, which was occasionally fatal. Cystitis would occur after excision even when there was a minimum of sepsis in the perineal wound; in the early days after excision it was mainly due to the disturbance of the hypogastric plexus rather than to exposure of the base of bladder to infection, because it occurred in his experience with equal frequency in males and females. The most serious cases occurred when the perineal wound was heavily infected.

He was a strong believer in tying in a catheter for five or six days after operation to prevent any bladder distension, and he used hexamine before and after operation. In some cases he had employed a small prophylactic dose of coli vaccine a week before excision.

Early growths meant easy excisions, and easy excisions less risk of sepsis and other complications, especially as regards the bladder.

Since he had adopted the perineal method for all true rectal growths he had operated upon more advanced cases, older patients, and worse surgical risks than he used to operate upon by the abdomino-perineal method; this meant greater risks as regards complications. He believed, however, that with every year's experience his statistics would improve, though the element of luck often flouted experience.

Case of Left Hydronephrosis Six years after Abdomino-perineal Excision of Rectum for Carcinoma Recti.

By W. Ernest Miles, F.R.C.S.

Mrs. C. Aged 63. Admitted January 15, 1920.

Complaint.—Bleeding from rectum on defæcation, nine months. Bowels regular, but recently some diarrhœa. No urinary symptoms.

Examination.—Nothing abnormal per abdomen. Per rectum: Cauliflower ulcerating growth completely encircling bowel 3 in. from anus. Growth freely movable.

Operation.—February 5, 1920. Abdomino-perineal excision of rectum. Very satisfactory convalescence.

Discharged.—April 13, 1920.

Re-admitted.—January 9, 1926.

Complaint.—Abdominal pain six weeks. Pain in upper abdomen, aching in character. No definite relation to food. Colostomy working well. No frequency of micturition, dysuria or hæmaturia.

Examination.—Abdomen. Smooth rounded tumour in left loin, movable on respiration, and having the characters of an enlarged kidney. Right kidney palpable and mobile, but not enlarged. No enlargement of liver or spleen. No evidence of abdominal or perineal metastatic deposits.

Investigations.—(1) *Urine.* Twenty-four-hour specimen: Total amount, 420 c.c. Reaction: Acid. Specific gravity: 1025. Trace of albumin. Urea: 3·6 per cent. Catheter specimen: A few red blood-corpuscles. Culture: A few staphylococci. Urea concentration test: 4·2 per cent. urea in 4 oz. of urine passed one hour after

taking 15 grm. urea by mouth. (2) *Blood.* 37 mgm. urea in 100 c.c. serum. (3) *X-ray.* No evidence of calculus in urinary tract. Left renal shadow enlarged. (4) *Cystoscopy and pyelogram:* By Mr. R. H. Jocelyn Swan, January 28, 1926. Some basal cystitis. Right ureteric orifice normal. Left ureteric orifice small. Ureteric catheter passed easily up left ureter for 13·5 cm.; definite obstruction at this level, i.e. brim of pelvis. 80 c.c. of sodium bromide (30 per cent.) injected up catheter, but returned at once into the bladder. Pyelogram showed that none had reached the renal pelvis.

February 1, 1926.—*Cystoscopy* repeated. Finer catheter introduced up left ureter, but caught in folds of mucous membrane, and could not be made to pass. Large catheter passed again to 13·5 cm., and then obstructed as before. 2 c.c. of 0·4 per cent. solution of indigo-carmine given intravenously immediately before cystoscopy. Blue urine seen excreted from right ureteric orifice after twelve minutes. No blue seen coming from left orifice at any time.

Conclusion.—Involvement of left ureter at brim of pelvis in scar tissue of abdomino-perineal operation, causing blockage of the ureter at this level, and subsequent hydronephrosis.

Section of Surgery.

SUB-SECTION OF PROCTOLOGY.

President—Mr. G. Grey Turner, M.S.

The Relationship of Proctology to Greater Medicine.

PRESIDENT'S ADDRESS.

By G. Grey Turner, M.S.

The Importance of Proctology.

Even a cursory peep into the History of the Treatment of Diseases of the Anus and Rectum shows the important position that these subjects occupied in the Greater Medicine of our forefathers. From the earliest times rectal diseases are mentioned in medical writings, and we are greatly indebted to Sir D'Arcy Power to whom we owe the translation of the manuscript of Master John Arderne, of Newark, "On the Art of Medicine and Surgery." This document was probably written in 1412 or thereabouts, and it gives a most interesting account of the practice of that time. The manuscript is illustrated by mediæval drawings, and those representing prolapse, pruritus ani, fistula-in-ano and hæmorrhoids are very graphic.

It is no little compliment to proctology that the figure on the medal of the International Surgical Congress, held in 1923, represents this old-time master in surgery. Those who are familiar with the original illustration copied from the Sloane MS., which appears as frontispiece to the "Treatise on Fistula in Ano, &c.,"—again edited and made accessible for us by Sir D'Arcy Power, will recognize the wisdom of omitting the patient from the reproduction!

After the time of John Arderne surgical writers like Paré and Wiseman and Heister devote much space to rectal disease and give clear descriptions of their symptoms and management.

King Louis XIV (1643-1715) suffered from fistula, for which he was operated upon. The disease thus became fashionable, and people boasted of the disorder as a point of honour. Does not comparatively recent experience in connexion with appendicitis show how history repeats itself?

Even in those days it was customary for some surgeons to devote themselves to special subjects, and there were those who cut for stone, others who cured hernia, as there were some who devoted themselves to the treatment of fistula and other rectal disorders. These early workers recognized the importance of the after-treatment and the often long period that must elapse before cure can be expected. Not infrequently they lived in the family of their patients, and during such residence in attendance on some important personage they carried out practice among the dependants of the house.

It is from the writings of Percival Pott, 1713-1788, that we learn of his thorough grasp of the subject, and his work on Fistula-in-Ano will repay the modern reader, for the rules which he enunciated guide us in the treatment which we use to-day. Up to his time the principles which underlie successful treatment were not understood, and the after-treatment was often too meddlesome and painful. To cure fistula, says Pott,

> Some of the most fatiguing and painful escharotics have been prescribed and used, troches and pastes made with sublimate arsenic, &c., but the method is so cruel and so inexpert that I will not waste the reader's time in saying anything more of it."

Nature will not tolerate such liberties, and persistence in this treatment

produced a callous sore which seldom healed. It was this type of treatment that Pott's writings did so much to relegate to oblivion, for he urged the simple division of the sphincter, with gentle careful packing of the wound.

What Pott has to say about the work of some of the irregular practitioners of his day deserves repetition.

"Why is it that we hear so much of miracles performed by the paste of one quack? and by the injections, oils, and balsams of others? when we all know that there is nothing specific for the cure of this disease (Fistula-in-Ano) in their compositions . . . . The truth is that, while we are looking for what these people do, we overlook what they do not do . . . It is, and ever must be, a first principle in quackery, to disapprove and condemn whatever has been done before, be it right or be it wrong . . . For these reasons they always order all former dressings to be immediately thrown aside and disused; and not having ingenuity enough to apply others with any degree of judgment, they make use of a simple plaster, ointment, or injection . . . . They, for want of knowing what to do properly, leave the conduct of the sore to nature, who, when the impediment of dressings (which often offend either in quantity or quality) are removed, will do much more than her too-officious assistants believe . . . . . The business of good surgery is to assist nature; but she will sometimes get the better, even of the worst."

Even a cursory examination of the works of these old writers shows very clearly how methods are discovered, practised for a time, forgotten and then re-introduced and hailed as new once more.

Many writers have drawn attention to the neglected state, or rather the precarious position, of rectal diseases in the welter of human ills, and Sir William Fergusson, writing about 1870, says:—

"Few surgical diseases are better known among the public than those connected with the rectum and the anus, yet there are few, perhaps, in which the surgeon generally shows to less advantage";

and the reason which he gives:—

"That comparatively few such cases are seen in ordinary dispensary and hospital practice,"

probably still explains why our graduates are not so well acquainted with these conditions as they ought to be. This aspect of the matter has been felt by many of us, and the position was well expressed in the opening sentences of a paper by my friend, the late lamented Hamilton Drummond.

"Fistulæ come under a branch of surgery which in a general hospital is apt to be neglected. Such cases are not, as a rule, of striking interest, and are frequently relegated to the end of the operation list, with the result that the operative treatment is not always efficient, whilst the patient is only too frequently sent out of the hospital to make room for more urgent cases before the cure is complete. Thus the post-operative treatment is not fully carried out, and the patient once more becomes the subject of chronic suppuration; for if there is one thing more than another that is essential to the healing of fistulæ, it is the careful dressing and attendance after the operation."

In these words I think the writer fairly reflects the position of proctology as it is suffered to exist in our large general hospitals and I fear among a large section of the profession outside.

During the last twenty-five years, diseases of the anus and rectum have been overshadowed, first, by the allurements of abdominal surgery, and secondly, by the general overcrowding of our hospitals, which has relegated not only the cases usually considered to be of little interest, but many that are really most important, to the waiting list, where they are too apt to remain. Fortunately, a comparatively small band of surgeons have continued to devote special attention to what is often looked upon as a subordinate subject, and have kept up interest in the matter much to the benefit of their patients, until they now find that general attention is again focused on the branch of surgery which they have fostered. In this survival and revival of interest in rectal surgery the special hospitals of London have played a great part.

In this country proctology has evolved out of general surgery, and this Sub-Section is a child and not the parent of the subject we choose to study.

May I digress for a moment concerning the question of title? In my capacity as President, I feel that it ill becomes me to offer comment, but, on the other hand, this is one of the few occasions on which one can speak on a matter of this kind when others may have the opportunity of offering criticism. In my view the word "proctology" suggests something mysterious, and in any case, in its literal sense it indicates a more limited field than we wish. I think it would have been wiser to be more explicit in the matter and to have spoken of the Sub-Section as devoted to the diseases of the "Anus, Rectum, and Colon," or simply "Anus and Lower Bowel."

When I say that proctology in this country has evolved, I mean to imply that those who devote special attention to this subject have undergone a thorough training in all the preliminary work which is so essential for those who practise greater medicine in any of its branches. But in these days, the field of general surgery is almost too great for any but the veriest giant to cover. In my view, the time has come when there must be subdivision of labour in the surgical field, and we must all of us, though perhaps carrying out general work, recognize the limitations of our capacities and must devote the best part of our time to some subdivision of the great field before us. In doing so, one has many regrets, but one may be comforted by realizing that we are but victims of the march of surgical progress. In any of the big hospitals the staff should agree among themselves as to the special field in which they intend to work. Some one of the surgeons should, for instance, take up the neurological cases, another the genito-urinary work, a third should become expert in, say, cleft palate and other special plastic work, just as some others may pay particular attention to proctology.

Diseases of the anus, rectum and colon are sufficiently multitudinous and various to justify this special attention. The experience of the war taught us how much might be gained by the opportunity for "mass" study of certain problems, and that has been abundantly shown where surgeons have devoted themselves to some particular subject. There are other reasons why bands of workers should devote themselves to special lines, for it is only in this way that they can command sufficient material to study groups of cases which would otherwise be looked upon as very unusual or even as great rarities.

The Necessity of a Wide General Training for the Proctologist.

There is no branch of practice in which it is more necessary to take a wide general view if pitfalls are to be avoided. For instance, there are many cases in which some general condition leads to symptoms which the sufferer refers entirely to the rectum. The congestion of the rectum, with its discomforts and burning pain, associated with cirrhosis of the liver, heart disease, and cyanosis are quite classical and not likely to be overlooked, but there is another class of cases in which the patient complains very bitterly of irritation at the rectum and of an increased amount of discharge, &c., in which the condition is entirely due to the abuse of purgatives or of enemata. In any of these conditions purely local treatment cannot bring relief, may do harm, and in any event will probably bring discredit. One is often consulted for symptoms supposed to be due to some obstruction or new growth in the rectum, in which the real explanation has been enlargement of the prostate. Some of these patients may even endure their urinary malady for so long that they develop prolapse of the anal mucous membrane, and it is only for this that they may seek advice. Under these circumstances, of course, treatment directed to the rectum can only be a failure. Sometimes, also, a surgeon is consulted about an inconvenient slight incontinence, or an inability to retain flatus, which is only an evidence of some early deep-seated nervous disease. The association of pulmonary tuberculosis and rectal abscess, though so well known, is not sufficiently recognized, and cannot be too much

enforced in teaching. I have been repeatedly struck by the entire absence of complaint as to the pulmonary condition which these patients make, and in very many, were it not for the rectal disease, the pulmonary trouble might become much more advanced before being detected.

There are other conditions found on rectal examination which may be confusing, as, for instance, the deposits in the pouch of Douglas secondary to malignant disease in the upper abdomen, which are every now and again looked upon as of local significance only, though they are not likely to mislead anyone who has been sufficiently trained in general diagnosis.

With regard to symptoms, I would just like to mention the danger of relying upon a story of any alteration in the stools. So frequently one hears about ribbon-like evacuations, or evacuations that are flattened in some way or another, which do not bear any relation to the conditions which are imagined to be present.

Again, the classical picture of constipation alternating with diarrhœa is very unusual in cases as we see them to-day, probably because fortunately we are consulted at an earlier stage. Increasing constipation in those who are habitually costive, or perhaps more important still, the development of constipation rather late in life in those who have previously been regular, are extremely suggestive of some obstructive growth in the pelvic colon. Similarly, the late development of piles, or the worsening of piles which may have been present for long, are very significant. Diarrhœa is so common that it is usual to treat it with medicines only for an inordinate time. Simple diarrhœa can only be a matter of a few days' duration, and any looseness that persists after that has probably an organic basis, and quite often the explanation will be found on a complete examination of the lower bowel. Intermittent colic is also very significant and should never be neglected in recurrent cases. Mucus in the stools is often a product of the imagination, but patients are unlikely to be mistaken about the presence of blood. That is always a symptom of significance, and any considerable hæmorrhage occurring past middle life is almost pathognomonic of a malignant growth in the large bowel and should prompt the most thorough examination.

While serving in the East I was much impressed by the story of a patient who told me that after spending ten years in India he contracted a dysentery followed by what was said to be piles. As he was due for leave, he came home and was treated medically without benefit. After a time a surgeon was consulted, who used the sigmoidoscope, diagnosed colitis, and started treatment by ionization. The patient had one treatment every seven days for eight weeks, but the condition became rather worse than better. Appendicostomy was now performed and the bowel irrigated with various solutions. While this treatment was carried out he stayed in a nursing home, on light diet, and was much improved; but as soon as he left and went on to ordinary diet his symptoms became as bad as before. At this stage a medical man who had practised in tropical countries saw the case and prescribed emetine. Improvement commenced at once, and before long the patient was well enough to return to India. It was about a year later that I removed the appendix in order to rid him of the annoyance of a rather frequent fæcal discharge from the appendicostomy.

So far, we have been considering cases in which general diseases have been the cause of rectal symptoms; but there is another equally important group in which a condition primarily rectal has given rise to symptoms of general disturbance. A simple fissure, for instance, may so greatly upset a patient as to be the cause of a nervous breakdown with loss of sleep and appetite. Not infrequently, patients suffering in this way do not complain directly of the pain, but of the secondary conditions to which it has given rise, and there is no condition which will more certainly upset the bowels and lead to a constipated state with secondary indigestion and ill-health. I have also seen patients who, as the results of a fissure, complain of abdominal pain in the cæcal region suggesting appendix trouble.

Similarly, piles may be a cause of very great general disability, and not infrequently the patient complains of the anæmia rather than of its cause. It is curious

that patients who bleed often have less trouble with the other symptoms. There are, doubtless, degrees of the hæmorrhagic tendency, and I have frequently noticed that patients whose main complaint is of hæmorrhage as a symptom, wherever that hæmorrhage may be, are the very cases in which there is likely to be trouble from bleeding after some necessary operation has been carried out. Similarly, piles may be the cause of otherwise unexpected sepsis, and I remember that one of the largest spleens I have ever seen was secondary to sloughing hæmorrhoids. It seems extraordinary, but nevertheless it remains a fact, that there are some patients who are suffering from very gross pathological changes in connexion with piles or other rectal troubles, but who never make mention of the fact, and it is in these cases that it requires something of the detective in medicine to discover the real cause of their troubles. Pruritus may be a cause of insomnia, and may in this way have a very marked effect on the health and well-being of the patient. Fistula is not only an inconvenience, but on account of the sepsis with which it is associated it may be a serious menace to health, though this is usually only appreciated with the improvement which follows its proper cure.

Very commonly supposed uterine or other pelvic troubles are looked upon as the cause of symptoms which are really the result of hæmorrhoids. This was first impressed on my mind by one of those chance remarks which I suppose we all remember as having been dropped by our teachers. Many years ago a wise physician told us the story of a patient who complained of some uterine mischief for which she had frequently been treated, and who, when an examination was contemplated, exclaimed: "O doctor, mind the piles!" In her case the hæmorrhoids were the source of all her troubles.

Impaction of fæces is another common condition which is frequently overlooked, and which I am sure often becomes a grave menace to life. It is so apt to occur at the end of a trying illness and seems particularly frequent in cases attended by jaundice.

The Application of General Principles in Proctology.

It is too often thought that surgery in this neighbourhood is essentially different from surgical interference in other parts of the body, whereas it is really the more general application of surgical principles which underlies the better results which are obtained to-day in the treatment of diseases of the rectum and anus.

The adoption of an antiseptic technique and general surgical cleanliness are most important. The principle of physiological rest for a healing wound is secured by division of the sphincter, and, as the history of the subject shows, it was not until that was generally recognized that the treatment of fistula was attended by any measure of success. That it is the *rest* and not the means which is essential is proved by cases in which the most complicated and intractable fistulæ have spontaneously and quickly healed after the performance of colotomy. This is a plan that ought not to be entirely forgotten when we are confronted with these cases, fortunately now becoming so rare. The opposite sort of proof is still frequently brought to our notice, for much time, patience, and, incidentally, money, are often spent in attempts to avoid operation and to obtain cure by treating fistulæ with vaccines, X-rays, ionization, &c. If these methods succeed, the diagnosis has almost certainly been at fault and the fistula has not been a complete one. After every such resort has been fruitlessly employed, such cases will heal quickly and kindly after physiological rest has been provided by simple division of the sphincter.

The principle of drainage must also be strictly observed in operations about the rectum, and any pocketing of pus or fæcal discharge will declare itself by general as well as local unhealthiness. Great benefit often follows the simple expedient of raising the head end of the bed.

Rectal surgery also provides many illustrations of the evils which may follow the violation of surgical principles. It is a proper surgical rule, much emphasized by

Syme in the old days, that a vein should never be perforated in the presence of a possible infection. For a time an operation for piles was popular in which the pile was transfixed by a silk ligature. This was a violation of this surgical principle, and my only death following a hæmorrhoid operation was due to portal pyæmia which arose in this way.

Operations ought to be planned with proper regard for the surgical principles involved, and their success is not always to be judged by the gross result obtained, but by the degree of perfection which may be legitimately expected. Operations for piles, for instance, ought to be followed by complete cure with restoration of the finesse of anal function. Judged by this standard, the Whitehead operation has often been found wanting, and I submit that it is because in this method the highly sensitive lining of the anal canal is replaced by the comparatively insensitive mucous membrane of the rectum.

At one of our earlier social functions it was playfully said by a distinguished guest that,

> "The cure of the ruts at the end of our guts
> Will admit of a varied technology";

and there is a wealth of meaning in the couplet. As long as surgical principles are not violated, there is room for enormous variation in technical details, and the explanation of the success of widely different plans of treatment will be found in the fact that they do not transgress surgical rules.

I have often thought that there was some justification for the American plan of speaking of "orificial surgery," which I take to mean the surgery of the orifices on the surface of the body. What strikes one first is the wonderful resistances of the tissues surrounding both the mouth and the anus to the particular organisms which normally inhabit these parts. Both regions must have acquired a special immunity, for in no other way can one explain how wounds either accidental or otherwise heal so kindly and without general disturbance, in spite of the fact that they may be bathed with the secretions peculiar to these parts. Judged by the other extreme there is great similarity; and, in the presence of a general lowering of resistance, both regions are a prey to virulent organisms which may set up at the one extremity cancrum oris and at the other gangrenous periproctitis.

Another bond of similarity is the way that tuberculosis attacks both regions as a secondary manifestation to its presence elsewhere.

The Examination of the Patient.

Nowadays, whenever an internal trouble is suspected, it has become the fashion to have an X-ray examination, quite regardless of the indications. Nothing is more common than to have patients coming for consultation and presenting portfolios of such photographs, usually very nicely bound, numbered and lettered. I have no hesitation in saying that these souvenirs of a visit to a radiologist are often most dangerous when placed without reserve in the hands of the patient. This fashion is now extending to the lower part of the alimentary canal, and examinations after opaque enemata are commonly made whenever any abnormal condition about the rectum or sigmoid is feared. This method may of course be most valuable, but frequently one finds that the other and relatively much more important methods of examination have either been omitted altogether or have been unaccountably delayed, sometimes to the great detriment of the patient. I often see cases in which the negative findings of the opaque enema have lulled the patient and his adviser into a position of false security, whereas an ordinary examination with the sigmoidoscope, or sometimes even the finger, would have early disclosed the serious condition which ultimately obtruded itself. No one will deny the help that X-rays can often give in the diagnosis of gastro-intestinal diseases; but none the less it must be recognized as only part of the examination, and to get its full value it must be considered in

conjunction with the other methods employed and be studied together with the whole features of the case.

The same applies to instrumental examination; yet when a student is questioned with regard to some condition of the lower bowel, and is asked what steps he would take to make a diagnosis, he frequently commences by saying that he would make a sigmoidoscopic examination!

It is most important to recognize that the ordinary methods of diagnosis apply to pathological conditions of the anus and lower bowel, and that the examination should be conducted in accordance with the usual routine so well expressed by Sir George Murray Humphry in his well-known aphorism: "eyes first and most, hands next, ears last and least." Further, it cannot be too strongly insisted that this ordinary examination must always precede any special examination. On an occasion like this it is not necessary to detail just exactly what examination should be made, but I would like to draw attention to the wisdom of making repeated examinations when the condition is in doubt. The old-fashioned plan of making the patient strain, as in defæcation, to demonstrate some abnormal condition is very valuable, and is not sufficiently used, and I vividly recall the many surprises that I have witnessed as a result of this method. To enable this to be properly carried out, the patient should visit the closet or use the commode, so that the straining can be carried out without fear of the consequences.

The sigmoidoscope is undoubtedly one of the most valuable of all the "scopes," and one of its essential virtues is its simplicity; nevertheless, it requires some training for its proper use, and very considerable experience before all the information which it is capable of yielding can be gleaned from its application. I well remember using this instrument in 1904 just after it had been introduced into this country. In the second case in which it was employed a calamity occurred, and I should like to mention the circumstances, because the damage arose from the fact that the instrument was passed blindly into the bowel, and not under the guidance of the eye as its originator insisted was necessary. I should have hesitated to mention this matter were it not that I not infrequently see the instrument used in this dangerous way, and observe that there is a tendency to suggest that its very simplicity makes it an instrument which is safe in any hands.

The patient was a man, aged 31, suffering from obstructive symptoms attributed to a growth in the sigmoid. It was decided to employ the new method of sigmoidoscopy, and this was assayed with the patient under general anæsthesia. The instrument was blindly passed with the obturator *in situ* and was easily pushed on for a few inches when an obstruction was encountered. The instrument was withdrawn and an attempt made to pass it again, but there was difficulty. Instead of immediately seeking the guidance of the eye, a little force was used, the obstruction was at once overcome and the instrument glided on easily. On now looking into the tube a good deal of blood was noticed, a cotton-wool swab was used to clear this away; this swab passed easily but was difficult to withdraw. On again looking into the instrument I was horrified to see coils of small intestine.

The abdomen was at once opened and a hole found in the sigmoid just above the pelvic brim. It was about an inch long and was a clean tear with bleeding edges. The small intestine was slightly distended, and the mass in the hollow of the sacrum, previously felt and presumed to be a growth, now appeared to be of an inflammatory nature. As there was obviously some obstruction a lateral anastomosis was made between a lower coil of the ileum and the rent in the sigmoid. The pelvis contained a little blood and mucus, but this was supposed to have escaped from the perforated sigmoid.

As was then the practice, the abdomen was thoroughly irrigated and a tube and gauze were brought from the bottom of the pelvis. The operation was well borne and for two days the patient appeared to be making normal progress. On the fourth day, however, signs of peritoneal infection were obvious, and death occurred on the next.

At the post-mortem there was pelvic peritonitis with infection spreading into either flank. On searching for a cause a second perforation was found in the upper part of the rectum just above the bottom of the recto-vesical pouch, and this had evidently been the source of the

blood and mucus which was mopped out of the pelvis at the operation. The original trouble was an inflammatory mass around a pelvic appendix, and this had caused the softening of the bowel which allowed perforation to be so easily produced.

What Proctology can offer to Greater Medicine.

First and most important, I must mention the very greatly improved results from the modern operations for cancer of the rectum. Expressed in figures it may be said that about 30 per cent. of cases who survive the operation of excision may be expected to be free from recurrence beyond the five-year period. In the hands of some who have devoted very particular attention to this matter, this figure is higher, and it is steadily rising all round. But this alone, encouraging as it is, does not fully express the great improvement which has taken place in the last decade, for during this period the operability rate has increased, while the mortality has diminished.

As the outcome of the study of the results of the earlier operations with regard especially to the frequency and situation of recurrences, newer and better operations have been worked out. This study has been primarily pathological; secondarily, anatomical; and finally technical, and this is the road along which all real progress in the treatment of malignant disease has been made. As you all know, past Presidents of the Sub-Section and Members have been prominent in this work.

Nothing is more likely to bring discredit on surgery than the improper selection of cases for operation, and in this matter great progress has been made, for in possession of the knowledge that there is no dissemination the surgeon need not be deterred by the mere size of the growth or its purely local spread.

I have in my possession a specimen of carcinoma of the rectum in which the growth had invaded the prostate and seminal vesicles to such an extent that both of the latter and a slice of the prostate had to be taken away with the growth (figs 1 and 2).

The urethra was repaired, but the patient developed a urinary fistula, which persisted for six weeks. In spite of this he eventually made a good recovery, and now, over *eleven* years after operation, he is in good health and free from suspicion of recurrence.

In another case, that of a man, aged 40, a large growth in the lowest part of the pelvic colon had invaded the bladder and had led to a recto-vesical fistula of twelve months' duration. The condition had been declared inoperable by an excellent surgeon, but one with no special interest in the treatment of such growths. In that case I was able to perform a satisfactory excision, and the patient is now in excellent health more than five years after operation.

Implication of the vagina need not be a difficulty, and even cases with so much implication as to render hysterectomy necessary have been operated upon with the happiest results.

Improvements in the treatment of malignant growth of the colon have also been very marked, and there is a really wonderful difference in the present outlook compared with that of not many years ago. There are a few outstanding reasons for this which have been universally admitted, and now everyone agrees that no attempt at resection and anastomosis should be made in the presence of obstruction. It is almost as readily agreed that cases do best, or at all events make recoveries attended with the least amount of anxiety, if a preliminary or coincident bowel drainage has been carried out. But I do not think that even yet the thorough mobilization of the growth is sufficiently appreciated. Over and over again I have seen cases that were declared to be inoperable, simply because the growth could not be lifted out of a central incision, but I have learnt that a large part of the fixation, or rather fixity, which is so often present in these cases is simply the result of inflammation or is even antecedent to the formation of the growth, and that such adhesions can be readily dealt with. By this step alone many a hopeless looking case has been converted into one easily operable simply by the very thorough mobilization suggested.

Another factor in promotion of success which has certainly been of great help to me, and which I would strongly recommend, is the importance of so planning incisions

FIG. 1. FIG. 2.

FIGS. 1 and 2.—Carcinoma of rectum involving the prostate. Excision by the lower route after preliminary colotomy. A slice of the prostate, the seminal vesicles, and the terminations of both vasa had to be included in the excision. There was a urinary fistula which took six weeks to close. The patient is now alive and well, and free from recurrence eleven years after operation.

that they directly expose the affected bowel. The oblique muscle-cutting incision in the right iliac fossa, which in Newcastle we associate with the name of Rutherford Morison, gives an excellent exposure for dealing with cæcal growths, and, in fact, growths up to, and including, the hepatic flexure. A corresponding incision on the left side is invaluable for dealing with growths in the sigmoid, and a similar incision just below the costal margin on the left side gives the best exposure for the splenic flexure. If, when operating through a median incision, I find that there is any difficulty in mobilizing a growth, I do not hesitate to cross-cut the rectus so as to bring the difficulties directly under the eye, and with the help of this thorough exposure it is only occasionally that a growth cannot be sufficiently mobilized to make its removal practicable.

I would also like to lay stress on the wisdom of bringing a strand of rubber tissue from the neighbourhood of the anastomosis. The incisions which I employ enable such a safety drain to be brought to the surface by a direct route. With extensive and complicated resections a little leakage may occur which the drain safely conducts to the surface, and I feel sure that the onset of peritonitis is often prevented by this plan.

As in dealing with the rectum, no mere local extension of the growth need deter the operator from dealing with colon cancer, and I have had successful cases in which the abdominal wall, the uterine appendages, and the stomach have been involved.

A comparatively recent case was a source of great encouragement, for it so well illustrated the value of exposure directly over the growth, and it was an example of the wisdom of not being deterred by the mere size of a growth or by its purely local extension. The circumstances are briefly as follows:—

The patient was a big stout man of 63, who was first admitted under my care in December, 1923, complaining of painful swelling in the left iliac fossa stated to be of only three weeks' duration. The onset had been gradual and the only complaint was of constipation, of pain in the left leg and of difficulty in walking. In a few days it became obvious that pus had formed and was reaching the surface. An abscess in connexion with a growth or a saccule seemed the most likely diagnosis, but there was nothing made out to confirm either. Under anæsthesia pus was evacuated, a track led towards the peritoneum, but communication with the bowel could not be established. The contents suggested actinomycosis, and this suspicion was said to be confirmed upon microscopic investigation. The abscess soon healed, however, and the man was apparently restored to health. Eight months afterwards he returned, the abscess remained healed, but the region of the scar was invaded by a hard raised growth forming quite a big mass in the substance of the abdominal wall. Except for constipation, bowel symptoms were still absent. I now excised an ellipse of abdominal wall, about 5 in. by 5 in., together with about 6 in. of the sigmoid, which was the seat of the primary growth. The continuity of the bowel was restored by end-to-end anastomosis, and a small rubber drain was left *in situ*. On removing the drain on the sixth day there was a good deal of fæcal discharge, this gradually lessened, and within five weeks the patient was able to leave hospital with the wound almost healed. When last seen, two years from the date of operation, this man was quite well and was working regularly. The scar was sound and there was no suspicion of recurrence.

The specimen (fig. 3) which I have brought with me this evening shows a typical carcinoma of the bowel with direct invasion of the adherent abdominal wall.

Simultaneously with this progress many misconceptions about colotomy have been removed. I think it is now generally recognized that an incontinent anus is better in the left iliac fossa than elsewhere. I am not aware that any type of operation can offer control over the artificial opening, but if a sufficiency of bowel can be left above the opening to act as a fæcal container, the patient can acquire a habit which keeps his disability within bounds, and there must now be thousands of people in this country living useful and not wholly unhappy lives in spite of this handicap.

Among the less important conditions there are many improvements of great

interest to record, and it is perhaps in regard to these that the practitioners who are representatives of greater medicine can be so helpful. I would like especially to speak of the prophylaxis of fistula-in-ano. In the old days it was customary to allow ischio-rectal abscess to develop and point before any incision was advised, and even now this practice is very often followed. As the result, the inflammatory process leads to the death of a large area of tissue in the ischio-rectal fossa, and if this does not include the wall of the rectum, the latter is so frequently left sequestrated that it must inevitably give way, leading to the formation of a complete fistula, when finally the abscess bursts or is incised externally. As has been pointed out by some of our Members, the early incision of these inflammatory foci

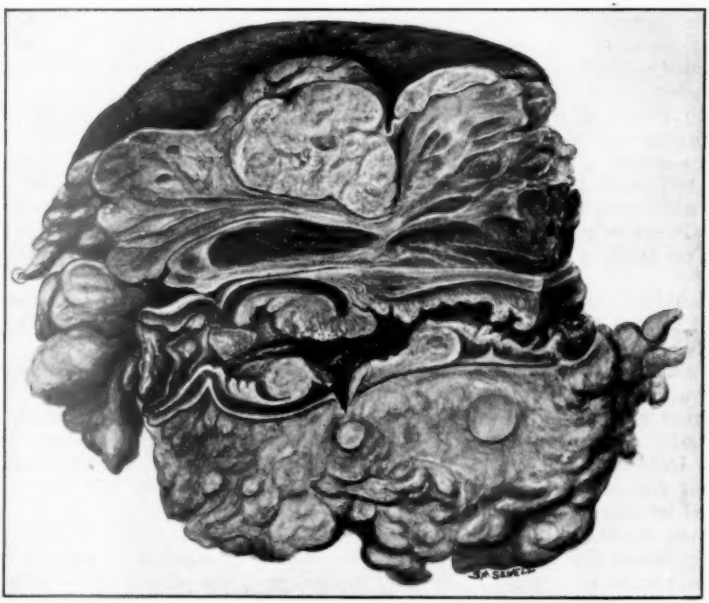

FIG. 3.—Carcinoma of sigmoid with direct invasion of abdominal wall and with secondary glands in mesentery. Resection with end-to-end anastomosis. Patient free from recurrence two years afterwards.

will at one and the same time cut short the disease and will frequently prevent the development of fistula. If this plan was universally adopted I have no hesitation in saying that fistula-in-ano would become a rare disease.

Then, again, I would like to discuss the necessity of treating all fistulæ by operation when they are small, or at all events, comparatively recent. No method short of division of the sphincter will cure a complete fistula, and time spent in trying other plans is not only time wasted, but is time ill used. When the external track of the fistula temporarily closes, either as the result of treatment or otherwise, the inflammatory process continues seething beneath the surface, forming those tracks which are so troublesome and which so complicate the after-treatment. Quite apart from this aspect, the longer a fistula goes on, the more surrounding induration develops and the more difficult will it be to bring about healing. While so far as I know there has been no real advance in the principle of treating fistula since the time that John Arderne insisted on the division of the sphincter, there

have been many minor modifications which have greatly simplified the cure if they have added a little to the difficulty of the original operation. I refer especially to the excision or division of the sides of the fistulous track, and to the necessity of cutting away the overhanging skin margins in such a way that the parts cannot fail to heal from the bottom with a minimum of attention, thus simplifying the after-treatment. It is, of course, important that the surgeon should see to it that the track prepared for healing is not so tightly packed with gauze by energetic dressers or nurses as to almost prevent the possibility of healing taking place, or at all events, to make it extremely prolonged.

I think further that those who are accustomed to see numbers of rectal cases have learnt that many of the tuberculous fistulæ are quite amenable to surgical interference, and that, indeed, in many cases they do very well. Quite often it is necessary to carry out the operation with local or spinal anæsthesia, but that is really only a detail in the treatment and does not involve the general conclusion that there is no necessity to deny these patients the benefits of operative relief.

With regard to the non-operative treatment of fissure. It is usually assumed that operation is the only method of relief for this condition, and many patients suffer great misery rather than submit to the knife, whereas, they might have been readily relieved by local treatment. The important point is to recognize that the fissure which can be *seen* and in which no surrounding induration is present, can nearly always be cured by local treatment, whereas the fissure which is persistently *hidden*, or which is associated with an abscess, invariably requires operative interference.

I would like also to put in a word for the "management" of cases of piles. I like that old word, for it is sufficiently expansive to include attention to the general health, the daily routine and medicinal measures as well as to operative treatment. It has so much become the fashion to look upon piles as a purely local malady necessitating operative treatment, that it is too frequently the only resort thought of. I think it is a very good rule not to recommend operative treatment for piles until they have really given rise to pronounced symptoms, otherwise the patient is almost sure to look upon the remedy as much worse than the disease, and there can be no doubt that it is operations on these ill-developed cases that are the most often attended by unfortunate results.

In the treatment of rectal polypi it is also most important to remember the tendency which they have to recur, and to recommend a period of careful watching lest the recurrence heralds the onset of malignant disease. In this connexion I know of no case which is a better illustration than one which came under my care some years ago, the main facts of which are as follows:—

The patient in question was a man of 33, who complained of piles of seven years' duration. Sometimes they became prolapsed and were then "as big as an apple." Three weeks before seeking advice he began to have severe hæmorrhage whenever the bowels acted. On ordinary local examination nothing could be made out except a doubtful thickening of the rectal shelf; but with the sigmoidoscope a large polypoid mass was seen lying in the dilated bowel above. This was easily removed, and at the same time several tiny "seedling" polypi were destroyed with the cautery. The main tumour was a typical adenoma about 2 in. in diameter. Fourteen months after the operation the patient reported himself as quite well, but almost immediately afterwards he began to suffer from a recurrence of bleeding. He did not, however, return for examination until another six months had elapsed, and by that time he was found to have a small carcinoma at the base of a recurrent polypus (fig. 4). The rectum was removed by a too limited perineal excision. The disease rapidly advanced and death occurred almost three years from the time at which the original polypus was removed.

Reproaches which Proctology must try to Remove.

We must never be content so long as it is necessary to carry out such mutilating operations for cancer of the rectum, and until we can get the cases at such a stage

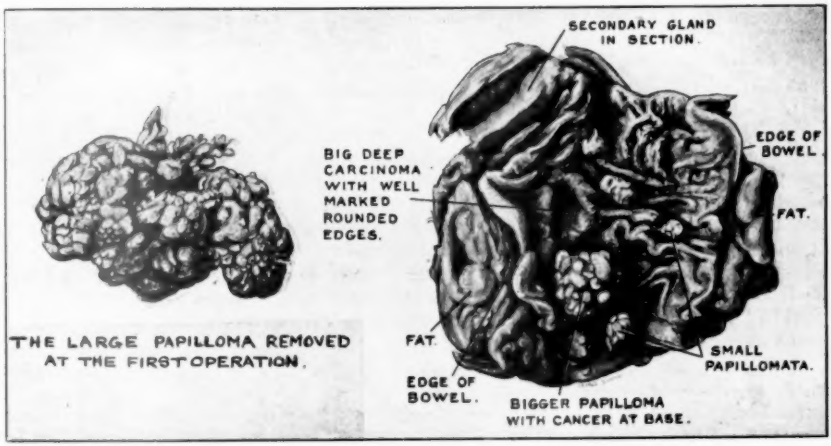
SECONDARY GLAND IN SECTION.
EDGE OF BOWEL.
BIG DEEP CARCINOMA WITH WELL MARKED ROUNDED EDGES.
FAT.
THE LARGE PAPILLOMA REMOVED AT THE FIRST OPERATION.
FAT.
SMALL PAPILLOMATA.
EDGE OF BOWEL.
BIGGER PAPILLOMA WITH CANCER AT BASE.

FIG. 4.—Recurrent papilloma of the rectum with development of carcinoma, which was discovered twenty-one months after the removal of the large papilloma shown on the left.

FIG. 5.—Syphilitic disease of rectum. Resection with end-to-end anastomosis and perfect restoration of function.

that we can safely carry out resection with anastomosis and restoration of function, the campaign as to the necessity of earlier diagnosis must be vigorously carried on. After all I do not know that it is entirely a question of earlier diagnosis, and I feel that we require more information about the origin and the types of new growth of this part of the bowel. But there can be no doubt that it is mainly a question of early diagnosis, and it is a considerable reproach to greater medicine to have to admit that many cases of cancer of the rectum come to the surgeon, not only after long-continued symptoms, but often after months of treatment. I believe that nothing more difficult than a more general resort to routine rectal examination and more frequent sigmoidoscopic examinations would bring many cases to operation at such a stage that the method of resection could be usefully considered. I must at once say that I am familiar with advanced cases in which the patients have themselves neglected their symptoms, or for some other reason have not consulted their medical attendant, so that some of the blame must rest with the public.

That the operation of resection may occasionally be performed with success is borne out by a record of my own cases.

I first gained some familiarity with the method in the case of a female patient suffering from a syphilitic stricture of the rectum within easy reach of the finger. It had resisted, or rather had relapsed, after persistent treatment of various sorts and finally colotomy became necessary. After this had been established for two years I resected the affected portion of the rectum, about 4 in. in length, and restored the bowel by direct suture (fig. 5). Soon afterwards the colotomy was closed. The result was so perfect that I yearned to be able to try it in a malignant case, but I had to wait for five years before a suitable opportunity presented itself.

It finally arrived in the case of a very intelligent man of 55, whose first symptom was rectal hæmorrhage, for which a medical friend advised him to consult a surgeon at once. When I saw this patient a growth could be felt within easy reach of the finger, and on inspection with the sigmoidoscope it was found to be about the size of a shilling and freely movable with the mucous membrane. A piece was removed for microscopical section and its malignant nature confirmed. The patient was a big, bulky man who would not contemplate colotomy. Without delay the affected portion of rectum was excised through a posterior incision, with removal of the coccyx. A segment of bowel about 4 in. long, and including its whole circumference, was ablated (fig. 6). A fæcal fistula developed which took some weeks to heal, and convalescence was made still more troublesome by retention of urine, which persisted for forty days and forty nights, and was greatly aggravated by the polyuria of chronic nephritis. In spite of these happenings the patient ultimately made an excellent recovery, and now, nearly six years afterwards, is alive and well without any suspicion of recurrence, and with perfect rectal function and control.

The second case was a female patient, aged 44, who came under my observation in the summer of 1922. She was suffering from a carcinoma about the size of half a crown, situated in the ampulla of the rectum. A colleague, in whose opinion I have the greatest confidence, had seen the patient and had advised her that the complete radical operation should be carried out. But the patient would not hear of the prospect of an incontinent sacral anus or a colotomy, and I had to accept the responsibility of deciding whether or not a purely local operation would be justifiable. I concluded that it would be proper to make the attempt because of the position of the growth, the fact that the first symptom was a recent hæmorrhage, and that the growth could be freely moved with the mucous membrane.

There are no features to remark about the operation except to say that I performed it after a preliminary colotomy. The patient made an uninterrupted recovery, and at the present date, three years and four months after operation, is in good health and free from any suspicion of recurrence and with perfect restoration of function.

In two other malignant cases I have performed this operation, but they were unsuitable, and their comparative non-success is not undeserved. So far as I am concerned, the technique of this method is not well established, but in its general plan the operation, as I have carried it out, is that described by Kocher and generally known by his name. Preliminary colotomy, though helpful in some ways, is not without disadvantages. Perhaps temporary cæcostomy or free division of the sphincter might fulfil the indications equally well. The development of an operation

of this sort is of great interest and importance, and will only come from those who are dealing with numbers of cases frequently. Experience must be added to experience before the lessons learnt are dimmed by lapse of time and in order that one may develop a familiarity with the cases suitable for the operation and with its technique. In order to establish the value of such a method we require exact and detailed information about the cases: that is what is so frequently lacking in our case

FIG. 6.—Early carcinoma of the rectum. Resection with perfect restoration of function. Patient remains alive and free from recurrence six years after operation.

reports, and is where much important work can be done by anyone who will take the time and the trouble.

Turning to matters less weighty in our eyes but all-important to the patient, pruritus ani is still ill understood, and as often as not resists our best efforts. It requires further accurate study in all its stages, and its successful treatment will

probably remain fortuitous until its pathology is better understood. In passing I would refer to thread-worms persisting from infancy as a causative factor, and to some such cases which have been cured by removal of the appendix even comparatively late in life. We might also ponder on the significance of the spontaneous relief or disappearance of pruritus with which we are all familiar.

Multiple polyposis (multiple adenomata) has so far resisted treatment and remains as a serious and menacing disease. I sometimes wonder if the analogy between this condition and the similar one furnished by bilharzia will furnish a clue to its pathology and better treatment.

So-called rectal neuroses are often baffling and disconcerting and worthy the careful study of the profession of Greater Medicine.

Colitis in its various forms proves most intractable, and the word probably includes a multitude of chronic ills with varying underlying ætiological factors. I have been impressed with the happy results that have followed the use of emetine in cases in which the amœba could not be demonstrated and in which the patient had never been out of England. Does not this suggest that this drug has an effect on some underlying condition of the bowel which, in association with the amœba, produces the familiar tropical dysentery?

Common Ground for Further Study.

As a subject for further study, I want to draw your attention to the remarkable toleration of the rectum as illustrated by cases in which the urine has been diverted directly into that part of the bowel by transplantation of the ureters. Altogether I have operated in this way for varying degrees of ectopia vesicæ in fourteen cases. Of the series, three patients have unfortunately died as the result of the operation; but the remaining patients have all been under observation for varying periods up to as long as 14 years, and form an interesting group. Out of the series there is only one who occasionally suffers from incontinence, and that only at night time.

The patient referred to is a lad of rather feeble mental development, whom I operated upon at the age of 19. It is eight years since the operation, and he is now a strong young man who works regularly on a farm.

None of the other patients has any incontinence. At first, and for a varying time, but usually only two or three weeks from the date of the operation, some of the patients have involuntarily voided urine, but after that, toleration has gradually developed and has become so good that they can hold their urine in the rectum for several hours with perfect comfort and without effort. Others have had complete control from the outset and in this respect the younger patients have been better than those operated upon later in life. It is very interesting to observe that the sphincter apparently remains quite unaltered, and that there is no unusual irritability of the lower bowel. I have noticed that, in two of the patients who have suffered from attacks pointing to pyelitis, there has been some incontinence during the period of attack, but not at other times. Though it does not strictly concern our subject this evening, my great interest in these cases leads me to say that though nearly all of the patients have at some time shown evidence of mild renal infection all may be said to be in good health.

One female operated upon at the age of 22 is now, eleven years afterwards, in good health, and the mother of two children. My first patient, operated upon 14 years ago, is a robust young man of 21, who works as a labourer in a shipyard. As an evidence of the efficiency of his renal function, I may mention that three years ago under general anæsthesia I performed Macewen's osteotomy on both femora without any unusual disturbance. This lad can go as long as 5 hours without emptying the rectum and without the slightest discomfort. On one such occasion he voided 10 oz. of clear urine from the rectum, not because of any urgent

desire, but in response to my request for a specimen. He does his work without inconvenience, plays football, and goes to the pictures.

As a further evidence of the competence of the sphincter let me quote the case of a boy of 8 on whom I recently re-operated for the removal of the exposed mucous membrane of the ectopic bladder. The ureters had been transplanted into the rectum nearly four years previously and he had acquired good toleration. During the administration of the anæsthetic there was no escape of rectal contents, and on passing a catheter through the sphincter 2½ oz. of clean urine were drawn off.

As a rule the rectal contents consist of highly decomposed urine mixed with the fæces in a liquid state; but sometimes a patient who is accustomed to pass this mixture will empty the rectum of more or less clear urine, and at another time will void an ordinary formed stool. The bacteriological fauna of the rectal contents is indescribable. In two cases I have examined the rectum with the sigmoidoscope, and beyond an unusual moisture, there has been no naked-eye sign of abnormal changes.

The Teaching of Proctology.

With this subject Greater Medicine has much concern. Personally, I felt the responsibility acutely when at a recent examination I was told by a candidate from my own school that she had never made a rectal examination! Probably we all agree that the primary object of teaching hospitals is to turn out good all-round doctors. With this object in view, diseases of the anus and rectum must not be taught as though a speciality but only as a branch of general work, and our main business is to teach the students the application of the general rules and surgical principles which we recognize as the foundation of our art.

In my view we ought only to endeavour to teach diagnosis, the general principles of treatment, and the detailed management of minor conditions, but so far as operations for major conditions are concerned, the student ought only to be expected to know the indications, the probable risks, something of the after-treatment, and the results that are to be looked for. He certainly ought not to be troubled with technical details of operations which he will never be called upon to perform, and which, in fact, he ought not to be encouraged to contemplate until he has taken out some such post-graduate training as will fit him for the work of an operating surgeon.

My concern is that students of the present day do not see sufficient of the simpler cases which are just of the sort that they will come in contact with as soon as they go into practice. As I have already said, most of these cases are now crowded out of the general hospitals, not because they are not recognized as important, but simply because there are so many other cases of greater urgency as well as magnitude which must of necessity claim the beds. These cases are, of course, still seen in the out-patient departments, but the student, though he may see and examine the cases, has not the opportunity of following them to the wards, so that there is a great lack of continuity in his teaching.

The type of disease we have under consideration is only suitable for demonstration to small groups of students, and nothing would be better than for the student to come in contact with these cases during their dressership; but there, unfortunately, they are in these days denied the privilege for the reasons which have already been mentioned. How extremely important for a student to have an opportunity of actually feeling the track of a fistula or of viewing at close quarters the outlet of a fissure with its tell-tale sentinel pile, or of feeling for himself on rectal examination the edge of a typical carcinoma, within easy reach!

For the sake of teaching, if for no other reason, I think the time has come when in busy hospitals these minor rectal cases should be welcomed in some easily accessible department, and I would further suggest that many of them could be

dealt with there and then by ambulatory methods. In spite of the fact that there are disadvantages connected with out-patient operative treatment, I think we must recognize that it is a method by which the usefulness of our hospitals can be greatly extended, and especially from the teaching point of view. In big cities where there are special hospitals, it appears to me that arrangements could be made whereby the class and the teacher could attend such a hospital, and in a short visit could be shown as many of the minor cases illustrating rectal surgery as he would be likely to see in many months in some of the bigger and more crowded institutions. But it would be a mistake if, from the teaching point of view, rectal cases were to suffer the fate of venereal cases and were to be segregated in one department seldom visited by students.

This educational problem is most important, and presents increasing difficulties as hospitals get larger and busier.

Section of Surgery.

President—Sir G. Lenthal Cheatle, K.C.B., C.V.O., F.R.C.S.

DISCUSSION ON THE TREATMENT OF DUODENAL ULCER.

Professor Charles A. Pannett, M.D., F.R.C.S.

There can be no shadow of doubt that a large number of patients ill with a duodenal ulcer get perfectly well, and remain so, under proper medical treatment. Equally beyond dispute is the fact that a smaller number who continue to suffer despite the most careful dietetic and medicinal remedial measures obtain relief by a surgical operation. These remarks are concerned with this latter group.

It is clearly impossible to devise and carry out any surgical procedure unless this be based upon some definite conception of the fundamental nature of duodenal ulceration. Of the various hypotheses of the origin and nature of gastric and duodenal ulcer, that which regards it as an infective lesion is the one which explains most satisfactorily the known facts of the disease. I believe gastric ulcer to be due to an infection with some specific organisms not as yet demonstrable, and that invasion of the stomach or duodenal wall takes place from the lumen of the alimentary canal. Conditions favourable to the growth of the organism would appear to occur at some stage in the interaction of the intestinal and gastric, or possibly pyloric, secretions. When the duodenal bulb, contracting in the presence of pyloric relaxation, causes regurgitation of its contents back into the stomach, they pass upwards along the gastric sulcus, the "Magenstrasse" of German authors. Here they meet the gastric secretions, and at some point along the lesser curvature the optimum conditions for the development of a gastric ulcer occur. When duodenal regurgitation fails we know how there is an apparent hyperacidity, and such patients are recognized as being prone to develop a duodenal ulcer. This is because, in the absence of duodenal regurgitation, the predisposing stage of interaction between the two secretions takes place now in the duodenum itself. Such an hypothesis explains the distribution of gastric and duodenal ulcers and is strengthened by the occurrence of gastro-jejunal ulcers. Here again the lesion appears, not as would be expected in the most acid cardiac region of the stomach, but where the gastric and duodenal secretions meet. These facts suggest that one way to induce the healing of a duodenal ulcer is to alter the environment of the organism in the duodenum. This, indeed, is done by gastro-jejunostomy, the most widely practised method of surgical treatment. But pathological observation also shows us that duodenal ulcers, like the corresponding gastric lesion, are very prone to become callous, to be surrounded by much inflammatory infiltration, and to become so rigid and poorly supplied with lymph that there are very great mechanical and physiological obstacles to the healing process. Just as in the stomach excision of ulcers has, in the long run, proved more effectual than gastro-jejunostomy, so it is suggested that excision of ulcers in the duodenum is on theoretical grounds a better method than the indirect.

Results of Gastro-jejunostomy.

Whether such a belief should be put to the test depends upon the results which can be obtained by gastro-jejunostomy. It is here that we traverse contentious ground. It is an undoubted truth that very many duodenal ulcers—even callous lesions—will heal after gastro-jejunostomy. There is not agreement, however, as to the proportion of cured patients resulting in this way. Elsewhere I have set out the statistics which have been published. It is here sufficient to say that some of the greatest authorities—Moynihan, Mayo, Sherren—claim 90 per cent. or more cures. Such great satisfaction with the operation has not been expressed by other surgeons of eminence, more especially those on the continent of Europe, amongst others Finsterer, Haberer, Clairmont, and de Quervain. This second group of authorities puts the cures down somewhere about 70 per cent. or less. In a small group of patients which I investigated personally, the cures amounted to 69 per cent. Forsyth's interesting researches amongst doctors who, presumably, would receive early and efficient treatment, showed that 58 per cent. remained free from symptoms after gastro-jejunostomy. Lewisohn found that a little more than one-half the patients are cured and that 18 per cent. suffered subsequently from gastro-jejunal ulceration. Smithies found that in 17 per cent. of cases gross hæmorrhages occur after gastro-jejunostomy. Sometimes this bleeding may lead to a fatal result. Very much rarer is the occurrence of perforation after gastro-jejunostomy. Nevertheless this has happened.

It has been suggested that the discrepancy in the statistical results is due to faulty operating, that the poorer results come from gastro-jejunostomy being improperly performed. This explanation is not adequate for the series I reported. In these cases there was no question of faulty technique. It would seem to me that a more probable explanation is that different classes of cases are being dealt with. If a surgeon operates only upon callous and inveterate duodenal ulcers, his results will not be so good as those obtained by one who operates upon the non-indurated ulcers of the anterior wall of the duodenum and includes them in his statistical results. For instance, I find very few soft ulcers of this kind on the operating table, because they seem to heal by the efficient medical treatment my patients have always received before resorting to surgery. Of twenty-eight resections of the duodenum, in 53·5 per cent. there were anterior and posterior ulcers, in 28·6 per cent. a single ulcer on the pancreatic wall, and in only 17·9 per cent. a single ulcer on the anterior wall. In favour of gastro-jejunostomy we may say that it is an easy operation to do and has a small mortality, but it is not without a measurable risk in the ordinary surgeon's hands. In a small series I reported three deaths after the operation, all of which were due to lung complications. I do not think generally it falls much below 5 per cent. The reported death-rate from a number of clinics is very much higher. The mortality after operation for a jejunal ulcer is high.

Partial Duodenectomy.

Turning to partial duodenectomy we are confronted with a difficult and tedious technical procedure, and very extensive surrounding fibrosis may make resection impossible, as indeed happens sometimes in the instance of a gastric ulcer. The risks of the operation are, in particular, injury to the bile or pancreatic ducts or to the pancreas itself. Yet with care they can be guarded against, so that the mortality of partial duodenectomy need not be high. Amongst the twenty-eight cases of my own there were two deaths, both from broncho-pneumonia. In one patient the common duct was cut across, but implanted into the duodenum. The patient is well.

Finsterer has been able to carry out seventy-one resections with only a 1·4 per cent. mortality. Whether partial duodenectomy will take the place of gastro-jejunostomy

will depend upon (1) the end-results obtained by the operation, (2) the development of a technique which will make the procedure more easily carried out. The last condition, however, is not absolutely essential. We do not yet know the end-results of duodenal resection. Finsterer reports 93·9 per cent. absolute five-year cures amongst sixty-three cases. De Quervain, a most careful and cautious observer, asserts that resection of the duodenum gives better results than gastro-jejunostomy, but he does not state figures.

Amongst sixteen of my cases in which the patients have been operated upon long enough to obtain some indication of end-results, ten are absolutely well, one eats anything and has such slight symptoms that he can almost be classed as an absolute cure, two have each had one attack of indigestion lasting a fortnight only, and in both of them it occurred approximately one year after the resection; one man has had treatment by his doctor for hyperchlorhydria symptoms, and one man, nineteen months after his operation, says he has a return of pain similar to that of his original trouble; the man whom I reported as having sustained an injury to his common duct has lost his indigestion pain completely, but probably he suffers from a mild cholangitis from time to time. He has never lost a day's work from illness since his operation.

These are the first few cases I operated upon by the method. The future alone will show whether partial duodenectomy should be substituted for gastro-jejunostomy and whether any modification in the method is desirable. A limited excision of gastric ulcers proved disappointing, therefore I believe it necessary to resect more than the affected segment of the duodenum and in my later cases I have been removing a part of the pyloric region of the stomach also. Axial union of the stomach to the duodenal stump is the routine to be followed, and is usually practicable. It was done in twenty-five out of twenty-eight cases. The digestive process would seem to be less disturbed by this means than by gastro-jejunostomy.

I am far from recommending the general adoption of partial duodenectomy for duodenal ulcers in the present state of knowledge, but I do insist upon the fact that the results of gastro-jejunostomy are not so satisfactory that there is no need to seek some improved method in the handling of these cases. Partial duodenectomy has shown itself to be a practical procedure without undue risk, and an investigation of its possibilities and results is certainly warranted.

Duodenal Hæmorrhage.

So much for uncomplicated duodenal ulcers. When bleeding occurs it is far more difficult to formulate a policy. In the first place there is a widespread belief that the hæmorrhage from a duodenal ulcer is never fatal. Whilst this is erroneous, the very existence of such a belief witnesses to the fact that many patients recover under medical treatment alone. Yet the risk is there and it is by no means negligible. As in any other kind of bleeding, the best treatment, theoretically, is the direct. But this presents exceedingly great difficulties. Any operation in an exsanguinated patient involves a risk, and an intervention should be as limited as possible. Unfortunately, serious bleeding usually proceeds from a branch of the gastro-duodenal artery, which means that the ulcer is situated upon the pancreatic wall or upper border of the duodenum. It is therefore difficult of access for excision, and ligation of the supplying vessels is not possible. Finsterer, indeed, advocates excision of the duodenum for hæmorrhage, but this is a method of treatment not to be lightly decided upon. On the other hand, I do not discard it absolutely as a method of treatment. Very recently I resected with success a callous ulcer stuck on to the pancreas in a man who, shortly before, had had a severe hæmorrhage, so that at the time of operation his blood contained only 54 per cent. of the normal amount of hæmoglobin. It was done without the aid of a blood transfusion, though

ordinarily this would seem to be called for. Should removal of the ulcer be considered too dangerous, opening the duodenum and cauterizing the ulcer, followed by gastro-jejunostomy, is worth a trial. Dunhill carried this out with good result in one patient. Nevertheless, hæmorrhage from a duodenal ulcer is of the secondary type and is prone to recur after simple ligation. Should the ulcer fortunately be on the anterior wall, as occasionally happens, excision followed by gastro-jejunostomy is undoubtedly a good procedure. Gastro-jejunostomy alone has been done for duodenal hæmorrhage. It is a most uncertain measure. I have seen two patients die from recurrent hæmorrhage shortly after it. Finally, there are patients who are too ill for any surgical operation to be thought of. Starvation, rectal salines, morphia, and blood transfusion with defibrinated blood because of the large amount of fibrin ferment present in it, are the measures to be used, and they are often effective. Too frequently the surgeon sees these patients only after repeated hæmorrhages. It would be infinitely better could the decision for or against surgery be taken at the earliest possible moment. The favourable time for intervention may easily be imperceptibly passed, but whether we should make it a rule to operate upon every patient with duodenal hæmorrhage, or await the progress of the case in the hope of spontaneous arrest, is a question about which there are not enough observations available at present to decide.

Sir Lenthal Cheatle, K.C.B., C.V.O. (President)

said that if he were in the unit working under Prof. Pannett he would ask that he might do post-mortem examinations on hundreds of cases, whatever might have been the cause of death, in the hope of discovering very early duodenal and very early gastric ulcers, as that was a form of spade work which really needed to be done. With regard to the possible cause of these ulcers, in the examination of animals which had died and happened to have been suffering from duodenal or gastric ulcer, the very small early ulcers were found to contain spirochætes; whether they caused the ulcers was a matter which required to be worked out. Only very early investigation would supply the solution. At present he was satisfied, in these cases, with the operation of posterior gastro-jejunostomy, and believed the main factor in the success of it was to make the stomach opening 4 in. in length; $2\frac{1}{2}$ in. was too small, for it allowed half the stomach contents to pass through the duodenum and half into the jejunum. With the larger incision very little passed into the duodenum.

Mr. A. J. Walton

said he did not agree that only a small proportion of cases of duodenal ulcer required surgical treatment; no proof had yet been advanced that medical means had cured or definitely improved actual ulcer in that situation. And certainly one should never wait for hæmorrhage to occur before undertaking surgical measures, especially as quite a number of these cases died from hæmorrhage, which was more fatal in duodenal than in gastric ulcer. Sometimes the surgeon was not called in until hæmorrhage had occurred, but an attempt at a diagnosis should be made as early as possible. He believed high acidity had much to do with causing these ulcers. He had never yet seen a case of pure jejunal ulcer. Post-operative ulcers started at the junction and were essentially gastro-jejunal. In 1062 operations on the stomach and duodenum, pyloric and duodenal ulcers numbered 437. In order to obtain a correct impression as to results it was essential to have a "follow-up" department and continually to review the cases. He had had such a department at the hospital since 1917 and that enabled him to be very definite when he spoke of results. Among patients traced for two years or more after operation the cases he had lost amounted to about 2 per cent. He agreed that simple gastro-enterostomy might be

followed by hæmorrhage or by perforation at the seat of the ulcer, and because of that he had advocated that this operation should be accompanied by bedding or suturing of the ulcer.

With regard to mortality he agreed that the usual conditions in a draughty hospital ward were the worst possible for these cases. Some hospitals had post-operative wards, and if these were to become general he was satisfied there would be an improvement in the mortality statistics of these cases as a whole. He considered that the mortality after gastro-enterostomy should not exceed 2 per cent. He had found that 90 per cent. of the cases after operation were really cured, and by that he meant that a man who worked hard had no reminder that he had a stomach and could eat anything after having gone six months without medical treatment. The great danger was that of gastro-jejunal ulcer. In his 437 pyloric and duodenal ulcers, gastro-jejunal ulcer occurred in 2·5 per cent. He thought faulty technique was a considerable factor in mortality figures. The operation suggested by Professor Pannett should not be done generally, because of the risks in less expert hands. And partial gastrectomy did not protect a patient from the gastro-jejunal ulcer. The aim of the surgeon should be to practise the least interference which would cure the patient.

Mr. H. W. Carson

said it must be agreed that the diagnosis of duodenal ulcer was not easy, as there was often so little to go upon, and even the services of the highly skilled radiologist did not give such a high percentage of positive results as Americans claimed. Also, chemical means had largely failed. Thus, one had to rely more and more upon the history given by the patient,—often a fallacious guide. This made it the more necessary to receive with a caution Professor Pannett's statement, that the majority of duodenal ulcers were cured by medical means,—a statement which he did not accept, though he agreed that duodenal *symptoms* could be medically cured. The opinion seemed to be increasing that these ulcers had a septic origin, and when the abdomen was open there should be a search for any septic focus within the accessible area. He asked whether it was the general view that the intermissions observed in cases of duodenal ulcer meant that the ulcer was then soundly healed and that the renewal of symptoms indicated that it had broken down again; also, was it right to do, in the quiescent period, a prophylactic operation in order to prevent the inevitable symptoms at a late date? Gastro-jejunostomy was not attended by a high mortality, and the great risk was not in the abdomen but from chest complications afterwards; and for that the surgeon must take his share of the blame. This operation, however, did not keep the degree of stomach acidity permanently lowered, and in those cases of a high activity there was reason to expect unsatisfactory sequelæ. If the latter were going to appear he thought they would do so within six months of the operation, and if not, then the patient was safe. If there was trouble years after the operation he did not believe it could be debited to the operation. He did not think an operation of the severity of duodenectomy was justifiable at present, certainly not for general performance.

Mr. C. H. Fagge

said that every surgeon should from time to time crystallize his thoughts as to what he had and what he had not seen, and the best way to get material for this purpose was to deal directly with lesions after the manner advised by Professor Pannett. He (the speaker) had never seen a jejunal ulcer and had had to deal with only three or four gastro-jejunal ulcers in all of which an unabsorbable suture was present and he could not escape from the conclusion that this was the chief factor in their causation.

In his opinion the majority of supposed pyloric ulcers were really duodenal: several times a pyloric ulcer sutured for perforation had at post-mortem proved to

be duodenal; he was under the impression that a paper from the Mayo Clinic showed, in a large number of operated cases, that only a very small percentage of ulcers in the stomach were pyloric. He had not for some years been satisfied with gastro-jejunostomy for the treatment of duodenal ulcer because an appreciable number of his patients suffered from hæmorrhage which investigations showed to be attributable to the original ulcer. In 1912, he found Dr. William Mayo excising a good many duodenal ulcers and from that time he (the speaker) had excised every duodenal ulcer which was possible under the circumstances; most of these were on the anterior surface of the duodenum, which was opened by a horizontal ellipse enclosing the supposed ulcer and the gap was then closed vertically: sometimes a posterior gastro-jejunostomy had been done as well. In every case the piece removed had shown an active ulcer; he had inspected the interior of the duodenum in every case and very rarely had he found a second ulcer. The chief information obtained from this was the realization that duodenal ulcers were usually smaller than gastric ulcers and sometimes were so small that they were easily overlooked; he felt sure he must have often done this.

Mr. T. P. DUNHILL, C.M.G.,

said he believed duodenal ulcer could be accurately diagnosed before operation in the great majority of cases and he did not open an abdomen unless the presence of an ulcer was revealed by X-ray examination. The surgeon should see the X-ray examination made himself. Information was often obtained on the screen that was not shown subsequently on the film. Ulcers were not all similar, and should not be classed together as regards treatment. He believed, with Professor Pannett, that, other things being equal, it was better that the stomach contents should not be delivered into the jejunum through a gastro-jejunostomy opening but should first be mixed with the bile and pancreatic juice. This was achieved by an operation of the Billroth No. 1 type. But other things were not always equal, and sometimes the advantages to be gained by resection of the affected part of the duodenum were overbalanced by the difficulties of the operation. All duodenal ulcers could not be classed together as regards operation. They differed in their evolution and their complications. Some were confined to the first part, and the duodenum could readily be mobilized beyond the ulcer. In this class he had performed a number of operations, following Dr. Schoemaker's method, and had felt that it was sound in the patient's interest. But with a deeply penetrating ulcer, in the second part, often accompanied by an inflammatory mass around the area, the difficulties of mobilizing the duodenum beyond the ulcer over-balanced the advantages; and in this condition a gastro-enterostomy was the wisest procedure. Then again, hæmorrhage from an ulcer modified the plan followed. This might be small and continuous, or sudden and severe. For these patients resection of the affected portion of the duodenum was not the right treatment.

The condition of most patients with duodenal ulcer was rendered enormously better by the operation of gastro-jejunostomy, though he did not think the proportion of patients cured was as high as Mr. Walton suggested. Medical men who had been so treated constituted an efficient "follow-up" department, and in their case there was evidence afterwards of greater sensitiveness to dietetic indiscretions and to excessive use of tobacco, as well as to overwork. Clearing-up of septic foci was an essential preliminary to any operative treatment.

Mr. C. A. JOLL

said he also thought that the skilled radiologist could give a high proportion of positive diagnostic results in these cases; out of fifty cases he had recently looked through, forty-nine had been correctly recognized in this way, the remaining one being

doubtful. Most of the cases, by the time they came to the surgeon, had already undergone medical treatment, and he did not think there was any evidence that duodenal ulcer had ever been cured by medical means. He believed a straightforward, well-conducted gastro-enterostomy would effect a cure in 90 per cent. of the cases: when there was serious bleeding a direct attack must be made on the ulcer by duodenectomy.

Mr. C. Max Page, D.S.O.,

said that during the last five years he had operated on many "second-hand" stomachs, and as a result he had formed a poor opinion of the efficacy of gastro-enterostomy; he believed that the operation, as generally carried out in England, had given a high percentage of bad results. He did not regard duodenectomy as such a very dangerous operation, and he advocated an intelligent trial of methods other than that of gastro-enterostomy in the treatment of duodenal and gastric ulceration. It should be remembered that a high mortality was always the price of a surgical departure before good results justified its general adoption.

Mr. V. Zachary Cope

said he did not feel satisfied with the dogmatic statements as to the failure to cure these ulcers by medical means. Even when the abdomen was opened one could not always tell whether a duodenal ulcer was present; inspection of the anterior wall only was not conclusive. He was sure acute ulcers sometimes healed spontaneously.

Professor Pannett (in reply)

said that he did not believe in a focal infection as a cause of these ulcers. He had cultivated streptococci, *Bacillus coli*, staphylococci and diphtheroid organisms from ulcers, and had injected intravenously into rabbits without result a streptococcus obtained from a minced surface-sterilized ulcer. He believed gastric ulcer to be due to a specific and, as yet, unrecognized infection. He therefore hoped people would not have their antra opened, tonsils enucleated and appendices removed without having the duodenal ulcer more directly treated. He agreed that when recurrence took place symptoms usually appeared within six months of the operation. His attitude was that stated by Mr. Max Page; he felt that if a promising new method in surgery was to be abstained from because it appeared dangerous, surgery would stagnate. It was true that duodenectomy in his first small series had been associated with a mortality a little under 7 per cent., but with increasing experience this death-rate would certainly be lowered. The reason why patients went through the operation with very little shock or other bad after-effects was partly due to the very limited exposure of the viscera, very often the small intestine was never seen. Resection was the right treatment for bleeding ulcers whenever practical, for hæmorrhage from gastric and duodenal ulcers was of the secondary type and likely to recur.

Section of Surgery.

SUB-SECTION OF PROCTOLOGY.

President—Mr. G. Grey Turner, M.S.

DISCUSSION ON THE VALUE OF THE CLOSED METHODS IN RESECTION OF THE COLON.

Professor John Fraser, M.C. (Edinburgh).

The operation of aseptic intestinal resection is a surgical procedure of considerable interest apart altogether from the importance which it has for us as a problem of surgical technique. It is evidently a striving after the ideal, an attempt to satisfy a demand. That the ideal has not yet been attained is evident from the multitude of methods which have arisen. In connexion with this paper the literature has been searched for some years past, and since Halsted described his method of anastomosis in 1921 some thirty-one different methods have been described, and therefore, whatever any of us may think of our individual methods, the multiplicity of techniques would seem to indicate that the perfect one has not yet been evolved.

Danger of Resection of the Intestines.

Resection of intestines is necessarily an operation full of risk. Details of a large number of operation results have been collected, and the conclusions may be summarized as follows:—Excision of small intestine has an average mortality of 4·6 per cent., the anastomosis of small intestine to large is associated with a mortality of 7·5 per cent., the results of colectomy as carried out in a single stage operation unaccompanied by a colostomy have the somewhat forbidding average mortality of 30 per cent., but when the operation is performed according to the technique of the two-stage method (Mikulicz) or when a preliminary colostomy is employed the mortality equals about 10 per cent. War records are not included in these figures. It is apparent, therefore (and it is a piece of very common knowledge), that resection of large intestine is an infinitely more serious operation than similar procedures applied to the small intestine or to the anastomosis of small bowel with large.

Recognizing the formidable nature of colectomy, we ask ourselves the reasons for the obvious danger of the operation. The more important considerations may be summarized as follows:—(*A*) The structure of the colon wall; (*B*) Peculiarities of blood-supply; (*C*) The nature of the contents; (*D*) The character of the bowel peristalsis.

(*A*) *The Structure of the Colon Wall.*

Beneath the endothelial lining of the peritoneum there is that portion of the peritoneal coat which has been called the tunica propria. In this layer the subperitoneal lymphatics and blood-vessels run, and recent experimental work has shown that the tunica propria is of considerable—possibly of vital—value in the prevention of the extension of infection from the bowel lumen to the surface. If the endothelial cell-covering is removed either by the edge of a blunt knife or by the application of a mild irritant no ill-effect follows, but, if the peritoneum is incised so as to destroy the tunica propria, infection spreads from the mucous area to the surface with ease and rapidity. Many of us have had practical experience of this truth in such cases as intussusception, where a small rent in the peritoneum, unnoticed and ignored, has been the site of a spreading and fatal infection.

It is a curious and a somewhat unfortunate fact that, while the tunica propria is well developed in the small intestine it is imperfect in the large bowel—the situation in which its presence would appear to be most required; and the deficiency is more marked in the lower than in the upper reaches of the large bowel. The comparative weakness of this structure in the large bowel is possibly a factor influencing the seriousness of colectomy.

Not only is the tunica propria deficient, but its place is taken by a tissue which is actually a danger in the presence of infection, namely fat. In stout subjects this tissue may so completely envelop the colon that it is difficult to find any extent of surface uncovered, so that its presence gives rise to serious difficulties in accurate approximation and efficient suturing.

Thereafter there is the further risk that in the presence of even a minor degree of sepsis the fat quickly necroses and sloughs. The comparatively small amount of submucous tissue in the large bowel is another factor increasing the unsuitability of this region from the point of view of operation.

It is also important to remember that in certain situations the relationship of the peritoneum to the colon wall is such that portions of the bowel are uncovered by peritoneum, and so come into contact with the retroperitoneal connective tissue, a space of high absorptive possibilities, profusely supplied with lymphatics; and infection, once introduced into this area, may make rapid progress to a fatal termination. In such dangerous situations the mortality of colectomy is increased by the occurrence of the highly fatal retrocolic cellulitis.

(*B*) *Peculiarities of Blood-supply.*

Several writers have pointed out the influence of the peculiarity of the large intestine blood-supply upon operative results. The blood-vessels are arranged on a somewhat sparse plan; the arteries supplying the colon pass round the bowel in a circular direction from the mesenteric border and are parallel to each other. There is very little anastomosis between the different vessels in the wall of the colon, and, though there is a comparatively free inosculation at the mesenteric attachment, the free edges of the bowel are by contrast very scantily supplied with blood. A profuse and active blood-supply is one of the best safeguards against the development of sepsis, and therefore the comparative sparsity of the colon-supply is a factor which must be taken into consideration.

(*C*) *The Nature of the Bowel Contents.*

Under natural conditions the bacterial content of the large intestine is infinitely more dangerous than that of the small bowel. When a chronic stricture exists, with the long-standing obstruction which necessarily follows, the infectivity of the colon contents must be immensely increased. The tendency to gaseous distribution which always exists is exaggerated by operative interference, and the combination of this with even a mild degree of sepsis must exert a considerable deleterious influence on any suture line.

(*D*) *The Character of the Bowel Peristalsis.*

According to Holzknecht the movement of the large intestine is in the form of a series of powerful "push" movements, so that by three or four such "pushes" the whole colon would be traversed. If such be the case, any large intestine suture line must necessarily be subjected to a degree of mechanical strain greater than that in any other portion of the intestinal tract.

In view of these various risks, and particularly because of the dangers associated with the almost inevitable sepsis of the open operation, it seemed reasonable to attempt to evolve a method of colectomy which, as far as possible, was aseptic in its immediate results.

THE EDINBURGH TECHNIQUE.

The experimental work in Edinburgh was carried out by Mr. Norman Dott, of whose co-operation I desire to make fullest acknowledgment. Some fourteen experiments were performed without a death. Dogs were chosen because the thick, resistant large intestine made the technique difficult, the blood-supply is not profuse, and being meat-eaters, their intestinal flora resembles that of man. The only special instruments required are the two ligature guillotines; the usual crushing clamps are employed, but controlling clamps are dispensed with.

The mesentery and lymphatic fields are mobilized as may be necessary, the segment of bowel to be removed is secured at each end by pressure forceps, the mesentery is perforated at these points, and is secured and cut so that a wedge-shaped portion is removed. Strong crushing clamps are applied to the gut close to the two pressure forceps, and the gut is divided between them at each end. The segment of bowel enclosed between the pressure-forceps, with its attached mesentery and lymphatic field, is removed *en bloc* immediately. The division may be made either by the electric cautery or by the knife; in the latter case the section is carried flush with the clamp, and the cut edge touched with liquid carbolic acid. The vessels of the resected mesentery are tied off. The ends of the gut are now to be ligatured, and it is safer to employ a purse-string suture for the purpose, in order to obviate the risk of its slipping. The ligature guillotine is threaded upon and placed about the middle of a strand of strong catgut and each end of the latter is armed with a needle. The suture is inserted close to the edge of the crushing clamp. Commencing with one needle

at the antimesenteric border of the bowel, a few points of sero-muscular suture are taken up, to terminate at the mesenteric attachment. With the other needle the procedure is repeated on the other half of the circumference. Thus, when the ligature is tightened, the guillotine remains attached to the antimesenteric border, whilst the knot is at the mesenteric attachment. As the clamp is released the ligature is drawn tight and tied as above. The end of the bowel is converted into a "blind end" with a minute stump of thoroughly crushed tissue projecting at its centre. The ease with which the stump can be invaginated into the end of the bowel should be tested, so that there may be no tension on the anastomosing sutures. If necessary the mesentery should be further divided to permit of easy inversion. It will be noted that the ends of the bowel have been prepared for anastomosis without at any time exposing the mucous membrane. They are aseptic and securely closed, so that they can be freely handled without apprehension of contamination.

It is convenient to close the gap in the mesentery in the first place, and the guillotines attached to the ends of the bowel, employed as tractors, greatly facilitate this procedure. The mesenteric borders of the ends of the bowel are approximated by a mattress suture, and three or four interrupted stitches, uniting the remainder of their circumference, form the first line of union. The stitches of tanned catgut should penetrate to the submucous coat. As they are tightened the stumps are allowed to invert slightly into the ends of the bowel. The ends form a double diaphragm across the lumen. The thin guillotines are allowed to project together through the suture line at the antimesenteric border. If the field of operation is difficult of access, it is well to pay special attention to the area of mesenteric attachment, inserting two or more superimposed mattress stitches before the remainder of the circumference is united. By this precaution easy access to this "danger point" and its secure closure are ensured in the most difficult case. A circular Lembert suture of fine tanned catgut is carried round the circumference of the anastomosis. Commencing at one side of the guillotines on the antimesenteric border, it passes round to the mesenteric attachment; the needle is passed through the mesentery eye first, and the suture continued, to reach the antimesenteric border again. It is completed by taking a loose stitch over the guillotines. The original ligatures on the stumps are now cut by means of the guillotines, and the latter are withdrawn. The loose stitch is tightened and tied off, so closing the point of exit of the instruments. In this way the stumps are released and intestinal continuity is re-established. In dealing with the human colon it is wise to superimpose a second continuous circular suture of linen thread or fine tanned catgut. It is essential to invaginate the bowel with the finger so as to open up the line of suture fully and completely.

[A number of slides of the operated areas at various intervals after operation were here shown. Even in thirty-six hours the peritoneum had united over the periphery, and in seventy-six days it was almost impossible to establish the point of junction.]

Professor FRASER continued: With regard to the application of the method in the human subject, I have only practised it a few times, and therefore I desire to be guarded in my recommendation of it. I am convinced, however, that under certain conditions, particularly in dealing with tumours difficult of access, and in the case of feeble, debilitated patients, the method has very real use and value. The speed with which the operation can be performed constitutes a strong recommendation for its employment.

The danger of producing a shelf must be recognized, and the risk associated with this is probably greater the lower the level of large intestine dealt with.

Mr. SETON PRINGLE (Dublin).

ASEPTIC RESECTION OF THE INTESTINE.

I THINK I can best open my contribution to the discussion by describing shortly the steps of the operation I carry out. In doing so I may say that, as my experience of the operation increases, I have found no reason to alter materially the method as first described. The operation certainly takes a shorter time and the risk of infection is greatly diminished as compared with the older methods. As we are only concerned to-day with the actual technique of the anastomosis I need not dwell on the necessity for very free mobilization of the bowel, nor need I discuss the extent of the resection which it is advisable to carry out for cancer situated in different portions of the colon.

When the points of section of the bowel have been determined and the mesentery dealt with, a large crushing clamp of the Doyen type, but with blades 3½ in. long, 1 in. wide and of the same width in their entire length, is applied at the point above the growth selected for

division. The crushed portion close up to the proximal end of the intestine is caught with fine but strong forceps. The blades of this forceps are $2\frac{1}{2}$ in. long by $\frac{1}{8}$ in., tapering to $\frac{1}{16}$ in. wide, with longitudinal serrations. The forceps is applied across the intestine so that the tip rests *just short* of the mesenteric attachment: it is important that the tip should not project beyond the margin of the crushed intestine. When this forceps has been placed, the crushed segment of the bowel close up to the edge of the portion to be removed is grasped in an ordinary heavy straight clamp. The intestine is then divided through the crushed portion, the knife, as it were, shaving along the lighter forceps, and liquid carbolic acid is applied to the cut edge. The intestine at the site for division distal to the growth is similarly treated, the light forceps being applied to the distal edge of the crushed portion. The edges of the divided mesentery are then united up to within an inch or two of the attachment to the bowel. The two light forceps controlling the ends of the intestine are held in apposition by an assistant. A needle carrying OO chromic gut is passed through the two leaves of the mesentery bounding the triangular space at the attachment to the intestine, and then picks up the bowel wall about $\frac{1}{8}$ in. lateral to the forceps and close to the mesenteric attachment. The needle is carried across, and the bowel in the other forceps is similarly picked up; the needle then emerges through the two leaves of the mesentery on the side opposite its original insertion. This stitch, when tightened, closes the mesenteric gap, and buries the tip of the forceps in a gutter of infolded intestine. A series of sero-muscular mattress sutures are then passed, burying the forceps from either side, so that when completed the only place where the serous coats of the intestine are not in contact is at the point of emergence of the forceps. Another layer of continuous or interrupted sutures is applied to approximate the intestine further; finally, the clamps are loosened and withdrawn and the small gap thus left sutured. When the suture line is completed, if the intestine is picked up between finger and thumb so that one lies above and the other below the line of anastomosis, a free opening will be found to exist between the two segments.

I have now employed this method in fourteen cases: Seven were resections of the colon alone; two were enterectomies of small intestine, and in five the ileum was anastomosed to the transverse colon after radical excision of the cæcum. In the latter cases the crushing clamp was applied obliquely to the small intestine so that the width of the crushed ileum in the grasp of the fine forceps approximated to that of the crushed colon, and no difficulty was experienced in carrying out the junction.

In this comparatively small series of cases I have had two deaths: One occurred in a man in a very poor general condition with an advanced carcinoma of the descending colon densely adherent to the lateral abdominal wall, and complicated by a pericolic abscess. It was indeed an error of judgment to attempt resection in this case, and he never recovered from the immediate effects of the operation, dying two days later. The other fatal case was that of a man aged sixty-eight with a "ring" cancer of the pelvic colon. He at first made excellent progress; the wound healed by first intention and there was absolutely no sign of intra-abdominal trouble; he had regular bowel movements on and after the fourth day; he was allowed up on the tenth day. On the fourteenth day his temperature rose to 102° F. and on the seventeenth day it was apparent that a thrombosis of the left femoral vein had occurred. His temperature continued to run an irregular course and a blood culture on two occasions gave a growth of a non-identified member of the *coli* group. His strength gradually failed and he died on the thirty-second day. As this was a private case I regret that I could not obtain a post-mortem examination.

I do not think that in either case can the technique of the anastomosis be held responsible for the fatal result. Apart from these two cases the results were very gratifying; the immediate recovery in all was remarkably smooth and in no instance was there evidence of intraperitoneal infection, although one case developed mild sepsis of the abdominal wound; in no case was there any trouble with the bowels. In those in which the resection was confined to the colon a cæcostomy was performed, either as a preliminary step or at the conclusion of the operation, and, following operation, a few ounces of liquid paraffin were injected each day into the cæcostomy until the bowels opened, with or without the assistance of a small enema. In the other cases the first movement generally took place on the third or fourth day, following the use of liquid paraffin by the mouth. In no case was there any evidence of the formation of a shelf or diaphragm sufficient to interfere with the lumen of the bowel and, in those cases in which the cæcostomy was allowed to close spontaneously, there has been no recurrence of the fistula.

This method is very similar to that you have just heard described by Mr. Fraser, and to an almost identical one used experimentally by Highsmith. There are, however, two points of difference which I consider of importance. First, in my method the bowel is divided through a previously crushed portion of the intestine so that the mucous membrane is never exposed and the risk of infection thus reduced to a minimum. Secondly, I think the use of forceps instead of encircling ligatures for controlling the ends of the gut during anastomosis, allows the infolding sutures to be placed closer up to the line of section and this lessens the probability of permanent shelf formation.

I think the chief criticisms to be directed against the method are two: (1) This same question of permanent shelf formation; and (2), the fact that mucous membrane is not sutured to mucous membrane.

As regards the first the experimental and clinical evidence shows that, if the sutures are placed carefully, as close as possible to the forceps, there is no risk of serious obstruction from this cause. In this connexion it is interesting to mention the method of closed colectomy which Halsted employed in forty-seven consecutive experiments on dogs, without a single failure. He closed the ends of the colon which were to be united by a purse-string suture of silk, and approximated the closed ends by a single row of mattress sutures, completing the operation by puncturing the complete diaphragm thus formed by means of a special guarded knife which he introduced per rectum and which, by means of a long flexible metal handle, he was able to pass up the large intestine to the ileo-cæcal valve if necessary. The shelf which must be left at the conclusion of such an operation is certainly greater than that produced by my method, and yet Halsted and his associates found that in the absence of trauma or soiling this shelf rapidly unfolded; in a series of twenty-nine cases examined at periods varying from four to one hundred and fifty-three days after operation it was entirely absent in five, only slightly present in seventeen and moderate in seven.

As regards the suturing of mucous membrane to mucous membrane the experimental work of Halsted already referred to proved that perfect healing resulted without it, and the clinical results also go to show that it is unnecessary. Some years ago Schoemaker described what I believe was the first method of closed intestinal anastomosis. He made a circular incision round the intestine through the serous and muscular coats and turned back a cuff of these layers, thus leaving a tube of intact mucosa on which he placed two small clamps close together, and divided the intestine between them. Having removed the desired segment of intestine the two ends still closed by the clamps were approximated, and end-to-end union made with an inner sero-musculo-mucous layer and an outer sero-muscular layer of stitches. The controlling clamp was removed as the last stitch of the inner layer was tied, and thus the anastomosis was completed without the lumen of the bowel having been opened during the operation. In a recent conversation he told me that, as a routine, he has now discarded the turning back of the sero-muscular cuff, and applies his forceps directly to the intestine, as he no longer regards the mucous suture as essential. In fact, the penetration of the mucous membrane by the stitches would, according to Halsted, only prevent the unfolding of the flange or shelf by increasing the soiling and consequent fibrous tissue formation.

Mr. J. P. Lockhart-Mummery

said he was not in favour of closed methods of anastomosing the colon as a routine, but he thought such methods were interesting and had advantages in certain situations, more particularly where the anastomosis would have to be done within the abdomen owing to the impossibility of drawing the bowel out of the abdominal cavity. This chiefly applied to growths at the extreme lower end of the pelvic colon. He believed that for ordinary routine colectomy a straightforward end-to-end anastomosis by the open method was preferable, and that with a proper technique there was no danger of sepsis. The improved statistics of the last two or three years were, in his opinion, not due to any use of the closed method, but to the more general custom of performing a temporary cæcostomy at the same time as the anastomosis. He looked upon this as the main factor in reducing the mortality.

There were, he thought, several objections to the closed method, the chief being that crushing of the bowel was alone relied upon to procure hæmostasis. Experience, however, had shown that crushing was not in itself a very reliable method of obtaining hæmostasis. Another objection was the presence of crushed tissue in the immediate neighbourhood of the anastomosis, which might be a starting point for sepsis in the bowel wall. After all, the main contention in favour of the closed method was that it ensured aseptic conditions. He doubted

very much whether this was so, as, where a large piece of bowel was crushed, he was not at all satisfied that the juice from the crusher was not a cause of sepsis. The evidence in favour of this juice being aseptic was not, in his opinion, reliable. His experience of the closed method was confined to only a few cases, in the treatment of which Martel's clamp had been used; this, he thought, was a very useful instrument in certain cases.

Mr. FREDERICK J. MCCANN.

In the practice of gynæcology new growths and strictures of the large bowel are not infrequently met with, necessitating for their treatment the excision of segments of the bowel, followed by subsequent anastomosis. I have always practised axial anastomosis, using three layers of sutures, a continuous suture for the mucosa and two layers of interrupted sutures for the sero-muscular coat. In the application of these sutures it is essential that care be taken to obtain apposition without constriction, so that the tissues are not devitalized or devascularized, thus preventing rapid union. I think that the reason why some surgeons are more successful in this department of surgery than in others is that they have acquired that daintiness in their work which is essential for continued success. The production of a "shelf" can be prevented by avoiding undue inversion of the sutured area, and it is necessary to remember this when passing the sutures.

A preliminary cæcostomy or colostomy is an essential point in cases in which obstruction has occurred, but the more frequent employment of cæcostomy will tend to reduce the mortality following excision of the large bowel, even where symptoms of obstruction have not occurred, for the bowel can be cleansed through the cæcostomy before the operation, while after the operation the cæcal opening provides an outlet for the contents of the bowel, thus permitting undisturbed healing of the anastomosis.

Mr. H. B. BUTLER (Guildford)

said that he had performed Professor Fraser's operation on two occasions. The first of these operations was a failure owing to shelf formation at the line of anastomosis. He had little doubt, after hearing Professor Fraser's description, that this shelf formation was due to his own failure in following the Professor's technique; he did not, for instance, shave off close to the guillotine those small tufts of tissue which had formerly been held in the Peyer's clamps; he, moreover, reinforced the suture line with an additional row of Lembert sutures.

The case which had been a failure was that of Mrs. S., aged 53, admitted to the Royal Surrey County Hospital, October 10, 1923, with acute intestinal obstruction. This was found, at operation, to be due to an enormous volvulus of the sigmoid flexure. The volvulus was emptied of its contents and reduced. When the patient recovered from this operation, she was advised to submit to a further operation and to have the offending loop of bowel removed. This she refused to do, and so left the hospital, but later she returned and requested that the operation should be done. On September 5, 1924, the second operation was performed, the portion of colon which had been involved in the volvulus being resected by Professor Fraser's method. The patient made a comfortable recovery and left the hospital.

On November 5, 1924, there was a Clinical Meeting at the hospital. A week before this meeting Mrs. S. was written to and asked if she would come and allow herself to be shown at the meeting. She replied that she was quite well and had had no trouble since leaving the hospital, and that she would be very pleased to come. On the very day of the meeting, however, she was re-admitted as a patient, having again become obstructed. She was not shown at the meeting.

She was very distended and was vomiting, but by dint of repeated enemata the obstruction was temporarily relieved. A barium enema, however, did not pass beyond the site of the anastomosis.

On December 2, 1924, a third operation was performed and the strictured portion of bowel was resected, this time by the open method. She again made an excellent recovery and has remained well since.

In spite of this failure he (the speaker) was much impressed by the speed and ease of performance of Professor Fraser's method. It was obvious, however, that the danger of shelf formation could not be ignored and that very great care must be exercised to avoid it.

The specimen of the shelf which had formed after the guillotine operation, was exhibited, and it would be observed that the orifice would only admit the passage of a fair-sized probe.

Mr. ZACHARY COPE

said that in addition to performing cæcostomy as a preliminary to excision of a part of the colon, he was accustomed to wash out the bowel by irrigating through the cæcostomy opening daily for several days before carrying out the excision. He generally used a solution of acriflavine 1 in 1,000 or 2,000. By this means the bowel proximal to the growth was thoroughly cleansed of obstructed material, and sepsis at the operation was less likely to occur.

Mr. W. B. GABRIEL

referred to a case of carcinoma of the hepatic flexure without obstruction, in which anastomosis was performed by Mr. Pringle's method. Cæcostomy was not carried out, and convalescence was uneventful, the patient leaving hospital three weeks after the operation. He (Mr. Gabriel) suggested that in the absence of obstruction, using the closed method, cæcostomy might safely be dispensed with, at any rate in the right half of the colon.

He also referred to the difference in technique of the various closed methods as regards the material used for suture, some surgeons advocating catgut and some silk or thread. Some examples of hardened catgut might apparently remain unabsorbed in the bowel wall for an indefinite time, as shown by one of Professor Fraser's microscopic sections seventy days after operation.

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T. WATTS EDEN, M.D.

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Section of Therapeutics and Pharmacology.

President—Dr. GEORGE GRAHAM.

Some Difficulties in the Use of Insulin.

PRESIDENTIAL ADDRESS.

By GEORGE GRAHAM, M.D.

AT the discussion on insulin, which took place in this Section two years ago,[1] the main concern of the speakers was to show that insulin was a very great discovery and that it could be used with safety, if reasonable care was taken. During the two years which have elapsed, it has been shown conclusively that insulin is a very potent drug. Some of the patients, who are under treatment with insulin, look and feel so well that no one would suspect them of having any disease at all, so long as the food which the patient avoids is unnoticed. The great majority of patients, if not quite so well as this, are immeasurably better than was possible before the discovery of insulin, and there is only a small minority of patients who remain invalids. There are, however, a certain number who, for various reasons, die in spite of the use of insulin. Although insulin is not a cure in the sense that the islands of Langerhans can be restored to their normal state, yet the patient has ceased to be a sick man and can take his place in daily life as a fit man.

Whilst the general position as regards insulin is satisfactory, there are many points of difficulty which arise in the course of treatment, and it might serve a useful purpose if I spoke this evening of some of the difficulties which have occurred in my own experience. For this purpose I have analysed the group of patients in the treatment of which I have taken a share during the last two years at St. Bartholomew's Hospital.

They have all been in hospital and are now attending in the out-patient department under our "follow-up" scheme. A letter is written to each one every three months, and it is only occasionally that there is any difficulty either in getting the patients to attend, or in hearing of their progress. The great majority attend every two or four weeks. Most of them have been in the wards of the medical unit under Professor Fraser, and I have looked after them nearly all the time. Some of them have been in the wards of Dr. Drysdale and Dr. Langdon Brown, and I have only seen them as out-patients since December, 1924. No case has been included which had not been admitted to hospital before January 1, 1925.

Patients treated with Insulin.

Died	18
Under treatment	68
	86

Patients treated without Insulin.

Died	2
Under treatment	16
	18
Total ...	104

[1] *Proceedings*, 1923-24, xvii (Sect. Therap. and Pharm.), pp. 1-12.

At first sight the number of deaths seems large, especially after what has been said about the value of insulin, but an analysis of these cases will, I think, provide the explanation.

TABLE I.

Patients never given Insulin before admission to Hospital.

Cause of Death.

Pneumonia	3
Pulmonary tuberculosis	1
Gangrene of lung complicating pulmonary tuberculosis ...	1
Total ...	5

Patients who died some time after Insulin was begun.

Most of these died outside hospital and no autopsy was performed.

Other diseases and conditions observed during the last illness:—

Influenza	2
Pulmonary tuberculosis	1
"Blood-poisoning"	1
Severe vomiting	1
Pyrexia, cause unknown	1
Cerebral hæmorrhage	1
Refusal to diet	2
Coma outside the hospital	1
Coma in hospital	1

Patients who were never given Insulin.

Cause of Death.

Pulmonary tuberculosis	1
Coma	1

This analysis shows that there was definite evidence in twelve cases that another disease was present, which had probably precipitated death. Two patients, who had refused to diet, died outside hospital, but the information received about them was scanty. In three cases no other disease was discovered. One of these died outside the hospital, and no sign of any other disease was discovered by the doctor in charge; the dose of insulin was only 20 units, and it is probable that an autopsy might have revealed the presence of some other disease. The other two patients died in hospital, one in the London Hospital, and Dr. O. Leyton told me that insulin had very little effect on his blood-sugar, and that no other disease was discovered during life. Only a partial autopsy was permitted, and no other lesion was found.

The other case which died in hospital is of great interest as the patient, a woman aged 30, was under close observation during nearly the whole duration of the illness. The disease began acutely, and she was admitted to hospital on May 29, 1924, some five weeks after the onset. At first the disease did not seem severe, as the blood-sugar fell to normal on dietetic restrictions alone. After four weeks she left hospital, taking 10 units of insulin a day. On September 8, 1924, only nine weeks later, the patient was readmitted, as the glycosuria had reappeared. She admitted that she had made a few minor alterations in her diet, but these did not seem sufficient to account for increase in the blood-sugar. During the next ten months she was in hospital under the care of Professor F. R. Fraser and Dr. G. C. Linder. The dose of insulin was steadily increased, and for some time before leaving hospital she had been taking 110 units of insulin on a diet which never contained more than 16 to 20 grm. of carbohydrate and a total of 1,800 calories in all. A most careful search was made for any source of sepsis. A slight discharge from one ear was present, but this had followed an operation on the mastoid four years before. The ear was repeatedly examined, and Mr. T. H. Just reported that no operation would assist the healing of the condition, and it subsided gradually under treatment. An acute attack of tonsillitis in April, 1925, caused an increase in the blood-sugar and insulin dosage, and the tonsils were subsequently enucleated, because the crypts were full of pus. During the nine months the weight increased by 29 lb., but the general appearance of the patient was always delicate. A week after leaving hospital a small amount of glycosuria occurred and, owing to a misunderstanding, no food and no insulin were taken for one day. On the next day the usual food and insulin were administered, but the

patient became drowsy in the course of the afternoon and she was sent into hospital. During the next fifteen hours before death occurred, 100 units of insulin were injected, but this dosage, which would have been ample for most comatose patients, had no effect on her. At the autopsy, performed by Sir Bernard Spilsbury, no other disease was discovered. The pancreas was small, but showed no naked-eye changes. On microscopical examination, the islands in the head, body and tail of the pancreas were much reduced in number. The staining reaction of the island cells was altered, and the cells resembled those of the acinous portion. No differential staining for alpha and beta cells was possible owing to post-mortem changes.

We must regard this case as one of a progressive degeneration of the islands of Langerhans in spite of adequate doses of insulin. I expect that this also occurred in the case of the man who died in the London Hospital. With these two exceptions, there is good reason to ascribe death in the other cases to superadded diseases.

The next point for consideration is the difficulty in maintaining the fasting value of the blood-sugar within the normal limits. I think that it is now widely admitted that this ideal in treatment should be attempted. So far I have only treated two patients, in hospital or nursing homes, in whom it has been impossible to attain this ideal. I expected that these would do badly, but they were both alive and fairly well two years after treatment was started.

One woman, whose blood-sugar in the morning before the insulin injection at 10 a.m. was never less than 0·18 per cent., now has a blood-sugar of 0·25 per cent. under the same conditions. She takes 35 units of insulin a day and her diet represents 1,000 calories. At first she gained weight rapidly, and now maintains her weight and is capable of doing her own house-work.

These two cases, notwithstanding, I still believe that it is a great advantage to the patient if the blood-sugar can be maintained within normal limits, provided always that no discomfort is caused. I have watched some patients in the out-patient department develop a high blood-sugar in spite of treatment, and have been able to measure the decrease in tolerance by the increase in the insulin requirements. It is, however, impossible to say for certain that the downward progress would have been more rapid if the blood-sugar had been allowed to remain high.

On hypothetical grounds, the patient has a greater reserve power and is freer from danger if he can maintain a normal blood-sugar for several hours after the morning dose of insulin is due. However well the patient may feel and look, I regard him as unstable if the morning blood-sugar is over 0·13 per cent.

I have always tried to keep the morning value of the blood-sugar below 0·13 per cent. By the term "morning blood-sugar" the fasting value is not meant, as the latter is almost impossible to obtain, after the patient has left the hospital or nursing home. The patient has his ordinary breakfast without any added carbohydrate, but does not receive any insulin. The blood-sugar in this series of cases is collected between 10.15 a.m. and 12 noon. This is a fairly severe test, since the blood is collected from two to four hours after the usual time of the insulin injection. A blood-sugar which is normal at 8 a.m. may have gone up considerably four hours later. This is a more useful test than collecting the blood some three hours after the usual meal and insulin have been taken. The patients have been divided into two groups—*mild* and *severe*. The criterion of severity which I have used is, whether insulin was necessary to lower the blood-sugar to normal or whether dietetic restrictions alone were sufficient.

The diet has varied a certain amount from case to case. The total carbohydrate was at first limited to 16 or 20 grm. in the hope that this would give the beta cells a greater chance of recovery, but I am bound to say that I do not think this has yielded the results anticipated, and I am now increasing it to 25 or 30 grm., in the severe cases, after the blood-sugar is normal. In the mild cases a larger amount—50 to 60 grm.—is allowed. The patients have all regained a great deal of the weight they had lost and are nearly normal in this respect.

TABLE II.

Severe Cases. Blood-sugar usually high between 10 and 12 noon.

Insulin		Blood-sugar maximum	
Morning	Evening		
36	17	0·18	
25	10	0·25	unreliable patient
20	18	0·30	
16	18	0·18	
15	14	0·18	
12	14	0·20	
15	5	0·18	
11	8	0·19	

Blood-sugar usually normal.

29	20	
22	20	
20	15	
17	17	
13	13	
8	15	
15	5	
16	0	
5	5	
22	2	Total cases 18

TABLE III.

Mild Cases.

Normal blood-sugar	32
Raised blood-sugar	11
No information	5

Cases treated without Insulin.

No glycosuria	8
Occasional glycosuria	8

Of the severe cases, eight out of eighteen have a blood-sugar which is usually between 0·14 and 0·18 per cent. Two patients have a blood-sugar over 0·20 per cent., but one of these is an unreliable patient and the blood-sugar always becomes normal a few days after being admitted to hospital; the other has only recently come to the out-patient department. In the mild cases the rise in the blood-sugar has nearly always followed an infection.

Various methods have been adopted to lower the blood-sugar, and these will be best explained by a consideration of the simplest cases.

(1) If a patient, who is only having one dose of insulin, has a raised blood-sugar, the morning dose of insulin is increased by two units in order to avoid giving two injections a day. If the increase in the insulin causes signs of an overdose at mid-day without lowering the blood-sugar, it is clear that a second dose of insulin is required. If the blood-sugar is only 0·15 per cent., a small dose of two to four units may be quite sufficient. If only a small dose is required, the actual time of the injection does not matter, and it can be given, either before or after the meal, so as to cause the least inconvenience to the patient. The risk to an adult of an overdose at night from such a small dose is negligible. When the morning blood-sugar sinks to normal, the patient may show slight signs of overdosage in the middle of the day, and as soon as this happens the morning dose should be reduced.

(2) If the morning blood-sugar is too high when the two doses are being taken, the problem is a little more difficult. If it is possible, an estimation of the blood-sugar some three or four hours after the insulin is of assistance.

The morning dose is first increased by two units at a time, and this may be sufficient to lower the blood-sugar. But the patient may show slight signs of overdosage before this occurs. Then the morning dose should be decreased at once, and our patients often do this themselves. If the morning blood-sugar is still high, the evening dose must be increased by two units at a time. It was originally taught

that the evening dose should always be smaller than the morning one, owing to the danger of hypoglycæmia occurring at night. This practice was observed for a long time, but recently the evening dose has been considerably increased in carefully selected cases. Some patients cannot take a large evening dose, and the following are extreme instances:—

Morning	Evening
36	17
36	15
25	15

On the other hand some patients can take a high evening dose:—

16	18
8	15
15	22

The explanation of this difference is not easy, as it is natural to assume that as the bulk of the food is eaten in the daytime the bigger dose should be taken then. The following case does, however, offer an explanation.

The patient, aged 9, developed an acute attack of diabetes mellitus while at school; this was recognized within the first week of the onset and treated at once.

As some slight diminution of sugar tolerance had taken place after nine months, small doses of insulin were given and for the next nine months, 4 units caused symptoms of overdosage, 3 caused none at all. In March, 1924, he developed pyrexia for two days and was admitted into hospital for observation. The boy seemed healthy but the blood-sugar was 0·20 per cent. Some three weeks later another bout of pyrexia set in and the signs in the lungs and the X-ray examination of the chest suggested that the bronchial glands were enlarged owing to tuberculosis. The temperature later on became normal. The blood-sugar fell to normal as the condition improved, and the insulin was reduced to 6/4. Then the blood-sugar increased again and the insulin was slowly increased without producing much effect. At this stage the evening dose of insulin was increased until it reached 17/22. The blood-sugar then became normal, and the insulin was gradually decreased. The boy has never had any symptoms of overdosage.

This case suggests that the high morning blood-sugar is here associated with the smouldering tuberculous infection. Patients with tuberculosis usually develop pyrexia in the evening and extra insulin may be required to keep the blood-sugar normal; thus the evening dose may have to be larger than the morning one. When the morning blood-sugar has become normal, as a result of increasing the evening dose, the patient may show some signs of hypoglycæmia in the morning, and a reduction in the morning dose of insulin will then be necessary.

Sometimes the increase of either the morning or evening dose may cause slight symptoms of overdosage, and I have seen two such cases. The interval between the two doses was only eight hours in one case, and ten hours in the other. These conditions had existed since the patient left hospital. As soon as the evening dose was postponed for two or more hours, the symptoms of overdosage disappeared and it was possible to increase the evening dose.

A criticism which may be directed against the method which I have used is that it may cause severe symptoms of hypoglycæmia. The patients are instructed about the symptoms, and know what to do, and often reduce the dose of insulin themselves. Actually, in the group of cases I have analysed, there have been mild symptoms of overdosage on a fair number of occasions in the form of limpness, sweating, &c., but they have always disappeared very quickly when either the next meal or some sugar was eaten. Severe symptoms have occurred on three occasions.

One man who was taking the evening dose too early became actually unconscious for one hour, but recovered without any treatment. Another man came to hospital complaining of a discharge from one ear. He attended for treatment in the Aural Department and some wax and sodden epithelium were removed. His blood-sugar that morning had been 0·26 per cent. instead of the usual figure of 0·15 or lower. A postcard was therefore sent that evening telling

him to increase the dose of insulin at night by 4 units. Four days later he was brought to hospital in the evening, as he had developed a hemiplegia. The postcard was brought with him and the house physician on duty recognized the possibility that the hemiplegia was due to hypoglycæmia. The reflexes were diminished and the plantar response was flexor. Sugar was therefore given and within three hours the paresis had disappeared.

Another man, not in this series of cases, has had serious symptoms on two occasions because he increased the dose of insulin too much and would not carry any sugar with him. On the whole the symptoms have been very mild in type. All patients are instructed to carry sugar with them and those taking large doses also carry a notice with them saying that they are taking insulin.

Another difficulty is the method of dealing with the minor and major infections which may occur in the course of treatment. It is well recognized that almost any infection may cause a rise in the blood-sugar, and perhaps glycosuria, in diabetic patients. The minor infections may do no more than this, but the major ones may precipitate coma. The correct treatment with insulin is not easy to carry out. At present, the patient is told to increase the dose of insulin by 1, 2, or 4 units as soon as a minor illness, such as a "cold in the head," begins, even though no sugar appears in the urine. As soon as any signs of overdosage appear the dose of insulin should be reduced. If this procedure is employed, it may be possible to prevent the fall in sugar tolerance which, in some cases, after a trivial cold in the head, has taken three or four weeks to pass away.

This method was employed in the treatment of a woman who had had diabetes for five years and then a mild attack of scarlet fever developed. Her insulin requirments were 28 units in two doses of 14 units. As soon as the condition was diagnosed, the insulin was increased by 2 units morning and evening although no glycosuria occurred at any time. The dose of insulin was increased in this way to 24 units night and morning, making a total of 48 units. At this stage rather severe reactions due to hypoglycæmia occurred, and the dose of insulin was at once decreased. At the end of this attack she felt well and has gained 7 lb. in weight and was having reactions with the original dose of 14 units night and morning. The case is especially interesting in that 20 units more insulin were taken without any symptom when the disease was active.

But if the infection is sufficiently severe to cause a glycosuria in spite of the small addition in the dose of insulin, much larger doses must be given.

Unless it is possible to make frequent estimations of the blood-sugar it is necessary to gauge the dose by the presence or absence of glycosuria. The urine should be collected as far as possible in three-hourly periods and tested for sugar. It is unnecessary to estimate the percentage of sugar present. The procedure is best explained by the description of a hypothetical case. If the patient, who has been taking 15 units in the morning and 10 at night, is taken ill during the night and if the urine passed at 8 a.m. contains sugar, whereas it is usually free from sugar, it is clear that the usual dose of 15 units will not be sufficient and an increase of 5 units should be made, making 20 units. The urine passed in the next three hours is bound to contain sugar, as the blood-sugar was probably over 0·20 per cent.; but if the dose of insulin is adequate, there will be no glycosuria in the period of four to six hours after the insulin. If so, the urine should be tested every three hours, and when sugar reappears 10 units of insulin should be given.

If, however, in the period four to six hours after the insulin the urine contained sugar, it is clear that the dose of twenty units was insufficient, and that the blood-sugar is probably still above 0·20 per cent. It is then safe to give another twenty units, and if the urine for the next four to six-hour period still contains sugar the dose of insulin should be increased to twenty-five units, and it may have to be very greatly increased. It is sometimes necessary to increase the dose of insulin to a very high figure—say 200 units in the day—and the increase in the dose may have to be made by ten or twenty units at a time, if it is obvious that the patient is not responding to the insulin.

The question of collecting the urine at night is an important one. If the patient is not seriously ill it is not necessary to do so every three hours, but if there is any danger of coma the urine should be tested, as this will give some clue as to the dose of insulin. The danger in the severe case lies in not giving enough insulin, but it does require a certain amount of courage to increase the dose of insulin from ten units to 200 units in the course of twenty-four hours.

One of the great difficulties of former years has disappeared since the introduction of insulin, as patients keep much more strictly to their diets and nearly always co-operate willingly in the treatment.

Discussion.—Dr. R. D. LAWRENCE mentioned the very marked effect of exercise in decreasing the blood-sugar, which was especially noticeable in people who constantly alternated between sedentary and active pursuits. He mentioned the case of a gardener whose diet had been constant for eighteen months. Last winter his regular insulin dose was ten units in the morning and six in the evening, which kept a good balance, his blood-sugar falling to 0·1 four hours after the dose. About May he began to work very much harder, and also took up cricket; after one week he suffered from dizziness caused by hypoglycæmia, and in July he was keeping a good balance with six units once a day. At the end of that month he stopped work and cricket, and his blood-sugar increased. He restored his balance with a dosage of eight units of insulin in the morning and of five at night. Following medical advice he returned to work and found that five units daily were then sufficient. He now carried out nine tests nearly every day, and had learned to adjust his own insulin to correspond with his activities. Another patient of sedentary habits who had been receiving sixteen units in the morning and twelve at night suffered from hypoglycæmia two or three hours after his Sunday tennis if he had more than ten units in the morning; eight kept him in good condition. He went on a vigorous holiday and for three weeks was able to double his carbohydrate intake on the same insulin dose without passing sugar. He even suffered from hypoglycæmia if he took exercise before meals. This exercise factor would account for the apparent improvement of patients on their discharge from hospital and return to active life.

Dr. E. P. POULTON said he had found that the mild cases of diabetes did better with small doses of insulin than with dieting alone. He described one such case of long standing in which, before beginning to take insulin, the patient suffered from giddiness on getting up suddenly, and this had disappeared when he was put on small doses. In very wasted patients there was a great danger in treating with insulin unless a large amount of carbohydrate was given. He also described one curious case which dated from the pre-insulin days. The disease began as a pancreatitis, with jaundice, and a mild diabetes followed. The patient was eventually treated with insulin, and the sugar tolerance curve remained more or less stationary. There was now, however, some slight degree of deterioration, and this patient had always the particular symptom of pain in the epigastrium and mild attacks of jaundice. Possibly disinfection of the gall-bladder might be attempted, but it seemed a drastic thing to operate on these rather slight indications.

Dr. G. A. HARRISON spoke of the special difficulties of treating diabetic children. Since it was essential to give a diet of sufficient calories to permit growth, the food intake had to be large. The difficulty was, therefore, to keep pace with these comparatively rich diets without giving too much insulin. Several American writers maintained that one injection daily was sufficient unless the dose exceeded 10 units, when it had better be divided into two or more. In several cases in which large doses were necessary three or four doses were given daily before meals, and another at midnight. The multiplication of doses, however, was extremely bad for children, partly because of the hardening effect on the skin and partly because of the alarm caused to the child by the whole process of injection. In fact, parents were often unable to give the insulin for this reason. The maximum number should therefore be reduced to two if possible, but severe cases tended to show a rise in the blood-sugar after a night's rest. With careful spacing of meals, however, and a 10 or 12 hours' interval between doses the blood-sugar could often be kept down. Parents should be told to supervise the exercise of the children in order to prevent a sudden drop in blood-sugar from this cause. In children intercurrent sepsis was liable to be very sudden and serious. The prescribed diet was very difficult to give when the child was sickening for some infection, and the doctor, hearing that all food was not being taken, was liable to fear hypoglycæmia and reduce the insulin or to

stop it altogether. Unless he could test the blood-sugar often, it was difficult to recognize the true cause of the anorexia. Insulin should never be stopped entirely, even if no food were being taken at all, as a patient suffering from an acute illness might have a large carbohydrate store. The family doctor must strike a balance between the increased requirement due to the sepsis, and the decreased requirement due to reduction in food intake. It was far better to send the child to a nursing home, but in the interval he might, as a general rule, substitute measured quantities of milk for the prescribed diet, as it was the only food most sick children would take. As a rough guide, if the normal dose of insulin were 10 units it should be reduced to 5; if over 10, then two-thirds of the usual dose should be given. Sugar should be kept at hand, but glucose should not be given with insulin as a matter of routine. The hypoglycæmic reactions of children were not so marked as those of adults; often an attack began with fretfulness and then the child became quiet and pale. It was naturally extremely difficult to distinguish these signs from those of pyrexia. He summarized the difficulties as in inverse proportion to the facilities for blood-sugar estimations.

Dr. C. H. BEST (Toronto) said that it was very interesting to learn that the problems confronting the clinicians in England were very much the same as those that confronted the clinicians in Canada. Cases which came regularly to the out-patient department seemed to progress comfortably; the trouble arose in cases which were seen only at irregular intervals. To overcome this difficulty the General Hospital at Toronto had developed a special branch of its social service department for keeping in closer touch with these patients. As the President (Dr. Graham) had said, the occurrence of infection in these diabetic cases under treatment was the great bugbear of the clinicians, and there did not seem to be any particular way of overcoming it except by early recognition of the infection and increasing the dose of insulin or adjusting the dietetic treatment. In the cases in Toronto in which there had been no injection progress had been very smooth. It might be of interest to state that the first patient who received insulin—a lad named Thompson, on January 11, 1922—was now a very healthy young man, and to all appearances perfectly normal. The experiences described by Dr. Lawrence were interesting, and in line with what one would expect from the increasing tolerance of diabetes after exercise, as noticed before the days of insulin.

Dr. P. J. CAMMIDGE remarked that it seemed to be assumed that all forms of diabetes were essentially the same. In his opinion there was a vital difference between the adult and the juvenile form. Juvenile diabetes had a distinct ætiology and origin. He had recently undertaken some research which would indicate that a constitutional high blood-sugar was a Mendelian recessive character. An animal with high blood-sugar produced a normal progeny if crossed with a normal animal, but the offspring of these showed a Mendelian proportion of individuals with high blood-sugar. Mice illustrated this principle very clearly and probably other animals would also. If it was, as he believed, a true Mendelian recessive, it would almost certainly appear in man as well. He had come to the conclusion that there was no such thing as a normal blood-sugar, but that individuals varied between wide limits. Low blood-sugar might also be recessive, but the experiments on this were not yet complete. The theoretical reason for these results lay in the interaction of the endocrine secretions. Definite chemical experiments had proved that insulin and adrenalin had opposite effects upon the activity of certain liver ferments. Insulin and pituitary extract, on the other hand, did not exercise opposite effects but chemically neutralized one another. Excessive doses of insulin, therefore, tended to exhaust the pituitary and set up diabetes insipidus in a mild form. Another influence at work in elderly diabetics was hyperthyroidism. There was no interaction between thyroid and insulin, but the thyroid activated adrenalin, which opposed the insulin. If the hyperactivity of the thyroid were diminished by diet and treatment, signs of overdose of insulin tended to appear.

A great deal of difficulty arose from always doing tolerance tests with sugar. It was rapid and easy, but people ate other things besides sugar, and much truer results were obtained from testing after an ordinary mixed meal. Another source of error was the practice of giving insulin half an hour before a meal and making the tolerance test three quarters of an hour afterwards. By this method the maximum of insulin reaction was reached considerably later than the maximum food reaction, especially in hyperthyroidic patients. If the insulin were given earlier, say, an hour or an hour and a half before the meal, the maxima would be more likely to coincide.

Section of Therapeutics and Pharmacology.

President—Dr. GEORGE GRAHAM.

Addendum to the "Discussion on the Treatment of Pulmonary Tuberculosis with Sanocrysin."[1]

Professor FRANCIS R. FRASER, M.D.

(From the Medical Professional Unit, St. Bartholomew's Hospital.)

THE work done with sanocrysin in the wards under my care has been carried out by Dr. C. F. Harris,[2] who is now abroad. These are observations, therefore, on the result of his work.

We have treated in all fifteen cases of tuberculosis. Of these fifteen patients, one was a boy with tuberculous adenitis and one a girl with tuberculous peritonitis, in neither of whom was there evidence of pulmonary involvement. Of the others, two were cases suffering essentially from abdominal tuberculosis, but these patients had pulmonary lesions also. During the course of the observations it has been found advisable to depart from the original scheme of dosage, and I propose to give an account of three cases in some detail as these illustrate the alterations in dosage that were adopted and also the principal results obtained.

Case I.—The first case treated was that of a man aged 30 who had had hæmoptysis eight years previously and who had had two further attacks of hæmoptysis, but who was in good condition when treated. He was afebrile, and was working as a hospital porter. Tubercle bacilli were present in his sputum and there were signs of fibrosis at the right apex, with râles after coughing. Although the disease was still present there was no evidence of recent spread. The first dose of 0·5 grm. caused no reaction or other effect and was followed three days later by 1 grm. Nausea and vomiting occurred later in the day, and on the second day after the injection the temperature commenced to rise and reached 104·4° on the fourth day after the injection. On this day a morbilliform eruption appeared; later this coalesced and spread all over the body and did not disappear till the tenth day after the injection. Albumin had appeared in the urine immediately the treatment was commenced, and on the fifth day after the second injection it suddenly increased greatly in amount. The patient felt very ill; he was eating nothing, he vomited and complained of a metallic taste in his mouth, which showed a thick white fur on the tongue, fauces and soft palate. On the eleventh day after the injection he seemed to have recovered from the effects, except that he had lost 10½ lb. in weight. The following day he was given another dose of 1·0 grm., which was followed by another reaction even more severe than the previous one, during which he had one alarming collapse. The rash was very irritating and the patient lacerated his scrotum in attempts to obtain relief. The febrile reaction lasted a week, but it was not considered that he was sufficiently recovered for further treatment until the twenty-third day after the injection. At this time he had lost 23 lb. from his original weight.

[1] See *Proceedings*, 1926, xix, Sect. Med. and Sect. Therap., Joint Disc. No. 4, pp. 53-70.
[2] Lawrence Research Scholar, St. Bartholomew's Hospital.

The next dose caused a short, sharp reaction during which he again showed signs of collapse, but the subsequent doses gave rise to no febrile reaction, although the albuminuria was increased, and the anorexia and metallic taste continued. At the end of the course of injections the physical signs were but little altered, except that no râles could be elicited and no tubercle bacilli could be found in the sputum. X-ray examination of the lungs showed a slight clearing in the shadows at the right apex and the appearance of a cavity there. He was discharged to Frimley Sanatorium, where he regained the weight he had lost. Very shortly after the end of the course of injections the râles had returned, and a little later tubercle bacilli were again found in his sputum.

From our experience in this case we decided that such severe reactions must be avoided, not only because it would be difficult to induce the patients to go through such an experience, but also because the harm such reactions might cause was unlikely to be compensated by any possible beneficial action of the treatment. From our experience in this case, and in later cases, we further decided that even if some of the disturbances to appetite, digestion and kidneys might be due to the effect on the tuberculous tissue, much of these undesirable results was due to heavy-metal poisoning. We arrived at this conclusion on finding the most severe nausea, vomiting, loss of appetite, albuminuria and general wretchedness following some of the later injections in a course, although they were not followed by any form of temperature reaction. It was decided, therefore, to raise the dosage more gradually so as to avoid excessive reaction, to leave longer intervals between doses and to stop the treatment as soon as a single dose of 1·0 grm. had been reached, so that the chances of gold poisoning would be reduced to a minimum. The effects of serum in the first case, and in a few others in which it was tried, were so disappointing that it was decided that reactions severe enough to need serum must be avoided. These principles were followed in the following case:—

Case II.—The patient was a man, aged 22, who had had a history of successive attacks of pleurisy during the preceding fourteen months, of increasing weakness, of enlargement of the cervical lymph glands three months before treatment, and of acute pleurisy within two weeks of commencing treatment. He was thin and pale, and the daily temperature variation was from 97° F. to 100° F. There were signs of extensive lesions at both apices, both recent and old, and of recent active disease in both lower lobes also. In this case, therefore, there was severe, acute, progressive disease with steady deterioration for some months. Commencing with an initial dose of 0·5 grm., the second dose of 0·75 grm. was followed by a slight brief reaction; the third dose was therefore reduced to 0·5 grm., and the dosage was not again increased until no effects were noted at that dose. In this way no severe reactions occurred, and the dose of 1·0 grm. was reached at the seventh dose, fifty-two days after the first. The interval between doses was never less than seven days, except that the second injection followed the first by three days only, and an injection was never given until five to seven days after all effects of the previous injection had passed off. In this case the physical signs were unaltered, except for a striking disappearance of râles, but X-ray examination showed some clearing of the shadows in the right upper lobe. The patient's general condition, however, was more satisfactory than was expected, and if he was not improved he had not become progressively worse, as had been expected. A week after the last injection an attack of acute pleurisy developed on the left side. This subsided satisfactorily, and the patient was discharged to a convalescent

home, at least none the worse for his treatment. He never lost the bacilli in his sputum.

Case III.—A similar plan of dosage was carried out, except that by this time we had adopted the practice of leaving seven instead of three days between the first and second injections. The patient was a female, aged 38, who had had five months' history of cough, sputum and loss of weight. The temperature at times touched 99° F., but she was practically afebrile, with an average pulse-rate of 90. Bacilli were constantly present in the sputum, which averaged 50 c.c. a day. At the right apex there was an extensive area of markedly impaired resonance and feeble breath sounds, and on the left side slightly impaired resonance above the scapula. Numerous fine râles were heard over the area of impaired resonance on the right side. X-ray examinations showed a cavity at the right apex and extensive fluffy shadows over the upper part of the right upper lobe. An initial dose of 0·5 grm. caused nausea and vomiting but no other evidence of reaction. A second dose, seven days later, of 0·75 grm. caused a sharp rise of temperature to 103·8° F., nausea and vomiting and a general feeling of wretchedness. The temperature fell in the evening, but rose next day to 101° F. with vomiting and the appearance of a rash that spread rapidly, but faded in thirty-six hours when the temperature had again settled to normal. On the fourth day after the injection the râles had practically all disappeared, and the impaired resonance at the right apex had largely disappeared. The third injection was given eleven days after the second, and the dose lowered to 0·5 grm. Except for slight nausea and vomiting there was no reaction. Before the fourth injection X-ray examination showed a remarkable clearing of the shadows at the right apex. The fourth injection of 0·75 grm. was given seven days after the third. It caused a mild febrile reaction, but the nausea and vomiting were distressing and lasted all day. A fifth injection of 1·0 grm. was given nine days later, and although there was no febrile reaction, the nausea and vomiting, headache and metallic taste in the mouth were very distressing and lasted for nearly two weeks, so that it was decided to stop the treatment. This patient did not lose weight, and although bacilli were always present they were greatly reduced in number. The remarkable disappearance of physical signs in eleven days and the X-ray evidence of clearing of the fluffy shadows in this case, constitute the most definite result that we obtained in our cases. It is doubtful, though, whether the result would not have been as good, or even better, if the treatment had been stopped after the second injection.

The result in one other case deserves mention. The patient was a female, aged 39, who had recently had an attack of pleurisy, but her abdomen was distended and contained large, irregular masses in the upper quadrants, another mass extending up from the pelvis on the left side, together with free fluid. *Per vaginam* the latter mass could be felt involving the left tube and ovary. During the treatment this patient's general condition improved in a striking manner and the abdominal masses became very much smaller. Unfortunately, after the first dose the pleurisy recurred, and a large effusion resulted that required replacement. At the present time, eight months later, she is still in good condition, but the effusion continues to form and to require replacement.

No definite effects were observed in cases of tuberculous adenitis or of abdominal tuberculosis other than those noted in this additional case just reported.

As to the other pulmonary cases, it is sufficient to say that no beneficial results were forthcoming perhaps because they were either too chronic for a good result to

be obtained, or too actively progressive for the beneficial influence to outweigh the detrimental toxic effects.

It is possible to see, in the skiagrams illustrating the cases not reported in detail, the disappearance of the more fluffy shadows, but in these cases the firmer shadows or older lesions dominate the picture.

We think we have sufficient evidence to show that sanocrysin has some action, so that recent exudative lesions in the lungs clear up more rapidly than is seen in other forms of treatment. We have no evidence of any other action, such as a direct action on the bacilli, and it is a question as to whether this action on recent pulmonary exudative lesions is of sufficient benefit to outweigh the detrimental effects of the treatment as originally introduced.

It is suggested that by reducing the size of the initial doses, lengthening the interval between the doses, increasing the size of the doses more gradually, and stopping the treatment as soon as a definite febrile reaction is obtained, the more detrimental effects may be eliminated and the main beneficial effects retained. We think the treatment deserves further trial along these lines.

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Section of Tropical Diseases and Parasitology.

President—Sir WILLIAM PROUT, C.M.G., O.B.E., M.B.

The Treatment of Leprosy at Kuala Lumpur, Federated Malay States.

By E. A. O. TRAVERS, M.R.C.S.

(General Hospital, Kuala Lumpur.)

THE Leper Asylum with which I was connected for about three and a half years is situated within about two miles of the town of Kuala Lumpur, in Selangor, one of the Federated Malay States.

In April, 1922, when the Asylum was put under my care, the conditions were much the same as in the majority of leper asylums at that time. Leprosy was regarded as an incurable disease, and the segregation of lepers was carried out by Government as a necessary measure with a view to the protection of the public.

There were about three hundred inmates, of whom some two hundred and fifty were Chinese and fifty Tamils; these had been arrested by the police in a more or less advanced condition of disease, or had been sent in by the medical officers of the various Government hospitals. Life in the asylum was a dull and depressing business, as it would inevitably be among a community carrying out what was practically a life sentence without employment or amusement.

During the year 1922 trial was made of the following methods of treatment:—

(1) A series of cases were treated by weekly injections of 0·45 grm. of neo-salvarsan. A course of eight injections was given without favourable result and the treatment was discontinued.

(2) Some twenty cases were treated by the injection of 1 gr. of tartar emetic dissolved in 10 c.c. of distilled water. In cases of extensive ulceration some improvement was shown, but the treatment had no effect on the general progress of the disease, and after a year's trial it was abandoned.

(3) The injection of the ethyl esters of the fatty acids of the oil obtained from *Hydnocarpus wightiana* seeds, recommended by Sir Leonard Rogers, was given regularly once a week to about forty patients. The prescription given by Dr. Muir, of Calcutta, was utilized, the dose being 5 c.c. The results of this treatment were very variable. In about 50 per cent. some improvement was shown, and one case improved rapidly, and to a remarkable extent. The main objection to this form of treatment is the pain caused by the injection. I found that it was evaded when possible by the women, children, and old people.

A trial is now being made with the pure oil obtained from *Hydnocarpus wightiana* seeds, with the addition of ½ per cent. of iodine. This is not quite so painful, but is not a suitable treatment for women and children.

THE TAI FOONG CHEE TREATMENT.

Shortly after taking charge of the asylum I noticed that nine of the Chinese lepers showed no visible signs of the disease. By the courtesy of Dr. Stanton, Director of Government Laboratories, these cases were carefully examined at the Institute for Medical Research, and five of them showed no trace of *Bacillus lepræ*.

I found that these men had been taking a form of Chinese treatment, to which they gave the name of Tai Foong Chee. This consisted of a powder made of the following ingredients:—

Tai Foong Chee (*Hydnocarpus anthelmintica*)	2 parts
Pak Chut Lai (*Tribulus terrestris* Linn.)	1 part
Foh Mah Yan (*Cannabis indica*)	1 „

In a copy of a very old Chinese pharmacopœia these are described as follows:—

Tai Foong Chee. (In English—"Great disease seeds." Grown in India, Burmah, and Siam. "A parasiticide, used in cases of ulcers, ringworm, and especially as a remedy for leprosy."
Pak Chut Lai. Grown in China. "Is heating and stimulating, a diuretic and expectorant."
Foh Mah Yan. Grown in China. "Is a stimulant, and increases the action of the lungs, liver and kidneys. Is used in the treatment of leprosy."

The Foh Mah Yan is the ordinary hemp-seed and can be easily obtained in any part of the world. As this treatment had shown such excellent results when taken by a few of the lepers themselves, I was of the opinion that if given systematically it might have great possibilities of benefit.

Description of Treatment.

Fifty of our lepers were accordingly put on the Tai Foong Chee treatment, details of which are as follows: The kernels of the *Hydnocarpus anthelmintica* nuts are carefully selected, all rancid nuts being rejected (these are bright yellow or black and can be easily distinguished from the sound kernels, which are light-grey in colour). The kernels are crushed in a mortar and the pulpy powder is passed through a coarse sieve, the residue being again crushed and sieved. The *Cannabis indica* seeds are crushed and sieved in the same way, the whole seed being used. (At the suggestion of Sir Leonard Rogers I have now eliminated the Pak Chut Lai from the treatment, and have increased the proportion of *Hydnocarpus anthelmintica*, with rather better results.) The powders are then mixed in the following proportions:—

Hydnocarpus anthelmintica	3 parts
Cannabis indica	1 part

Of this mixture half a drachm is given twice daily, soon after food. In the case of children the dose is reduced proportionately.

Method of Administration.

The patients collect round one of the attendants (a leper), who is provided with a pail full of the powder and a little aluminium measure, the capacity of which is exactly half a drachm. He measures a dose into each leper's hand; it is jerked into the mouth and swallowed down with the aid of a little water from an urn, which is placed at hand. As the attendant gives each dose he shouts the name of the patient, and another attendant makes a mark against his name on a large sheet of paper. The steward (a leper) stands by, to see that each dose is swallowed, and the number of doses taken each month by every leper is registered in a book kept by the medical officer. The Chinese lepers have become so extraordinarily quick and efficient at this work that over three hundred and fifty doses are given and registered in under half an hour. Every detail in connexion with the preparation and administration of the Tai Foong Chee treatment is carried out by the lepers themselves. The mixture should be made up fresh every week, as, if left for a longer period, it is apt to become rancid and irritating to the stomach. The nuts of *Hydnocarpus wightiana* are cheaper and rather more easily obtained than those of *Hydnocarpus anthelmintica*. I found, however, that when the mixture was made from the kernels of these nuts, the patients complained of gastric irritation and nausea.

The mixture tastes rather like Brazil nuts; not one in a hundred of the patients complains of any gastric irritation after taking it, and in such cases a few grains of bicarbonate of soda, taken with the dose, is effective.

The Results of Treatment.

Of 275 cases that have been under treatment for over three months, 218, or 79·2 per cent., show definite improvement.

The following table shows the results in cases that have been under treatment for two years:—

Cases under treatment for two years	Much improved	Improved	Not improved	Percentage of improvement
127	55	49	23	81·8

Negative Cases.

A case is regarded as negative when, after careful examination, no leprosy bacilli are discovered.

All examinations have been independently carried out at the Institute for Medical Research at Kuala Lumpur, and the method of examination has been as follows: The nostrils are carefully swabbed, and any discharge is examined. The sites of nodes if visible, and any scars, are incised, and the serum squeezed from them is examined. If no leprosy bacilli are discovered the case is pronounced negative.

During the year 1924, thirty-one cases showing no visible signs of leprosy were examined, and nine of these, or 29 per cent., were found to be negative. These cases had been under treatment for approximately one year.

During the first eight months of the year 1925 twenty-seven cases have been examined, and of these, fourteen, or 51·8 per cent., were found to be negative. These cases had been under treatment for approximately two years.

The following table shows the results obtained from 200 lepers, in all of whom the leprosy bacillus was demonstrated on admission, and who have been under the Tai Foong Chee treatment for between one and two years.

For purpose of comparison the results at the Culion Leper Colony are also given.[1]

	Total treated	*Improved*	*Negative*
Culion	2810 ...	71·7 per cent. ...	9·7 per cent.
Kuala Lumpur ...	200 ...	81 ,, ...	11·5 ,,

At Culion all treatment was by injection of the ethyl esters of chaulmoogra oil, with iodine, creasote, or both.

It is advisable that the Tai Foong Chee method of treatment should be carried out under the supervision of a medical officer.

Signs of reaction, which are characterized by fever (seldom rising above 102° F.), swelling and redness of nodes, coloured patches and general malaise, should be recognized at once and the treatment stopped.

The temperature usually falls to normal in a few days, the nodes shrinking and losing their red colour in a fortnight or so. The reactions are usually a favourable sign and are followed by rapid improvement in the general condition of the patient. In a few cases, however, the reaction is too violent and the patient becomes seriously ill; nodes break down and ulcerate, and there is a variable amount of general œdema. In such cases, after recovery from the reaction has taken place, treatment may be gradually resumed, smaller doses being given at first.

In about 2 per cent of the cases, irritation of the kidneys, causing nephritis, has occurred. To this attention is drawn by Dr. José Rodriguez in his report on the Culion Leper Colony mentioned above.

[1] "Progress of Leprosy Treatment Work at Culion Leper Colony," by José Rodriguez, M.D., *Journal of the Philippine Islands Medical Association*, vol. v, February, 1925, No. 2.

Under the Tai Foong Chee treatment, the urine of all lepers showing signs of œdema should be examined at once, and if albumin be present the treatment should be stopped. Dr. Rodriguez mentions choking, dizziness, chest pain, headache and hæmoptysis as occurring, in one form or another, among 43 per cent. of the patients treated by the weekly injection of the ethyl esters of chaulmoogra oil at Culion. This is not the case under the Tai Foong Chee treatment; the patients usually improve rapidly in physique and general health.

In a few cases, lepers who have apparently recovered are allowed to leave the asylum and return to India or China. The majority of them, however, prefer to remain in the asylum, where they have employment and are now very happy. They are given a pass and are allowed to go to Kuala Lumpur and back, always sleeping in the asylum. They are in this way kept under regular observation.

The Tai Foong Chee treatment is very popular with the lepers, women and children taking it as regularly as the men, and it is not often that any of them miss a dose. It is now compulsory for all new admissions. The only inmates that do not take it are very old, decrepit patients.

Importance of Personal Cleanliness and Active Exercise.

In the treatment of leprosy, personal cleanliness and active exercise are almost as important as medication.

There are now 500 lepers in the asylum at Kuala Lumpur; with the exception of nine Indian watchmen, who live outside the grounds, and who do not under ordinary circumstances go inside the gates, the whole staff of servants are lepers. The steward, schoolmaster, attendants, water carriers, sweepers, gardeners, cooks, washermen and dressers, all are patients. Forty-seven of them are so employed, and of these nine show no signs of leprosy and are negative on examination for *Bacillus lepræ*. The servants are paid a small salary, averaging about 7.50 dols. (Straits) a month. The dressers are more efficient and useful than non-leper dressers. Being lepers themselves they are not afraid to handle the cases; they cleanse and dress the ulcers, whereas non-leper dressers, who receive about twenty times the salary, object (not unnaturally) to actually handling the lepers. It is the duty of the attendants to see that all able-bodied lepers have at least one bath a day. A large number of lepers work in their own gardens or keep little shops, rear pigs, turkeys or chickens, and generally employ themselves in one way or another.

We have several carpenters, blacksmiths and masons among the Chinese in the asylum, and all repairs, erection of buildings, &c., are carried out by the lepers themselves. All the inmates, with the exception of a very few of the most decrepit, cook their own meals.

The amusements are varied. We have a club, built and managed by the lepers, with a gramophone and newspapers in Chinese and Tamil. There is an excellent theatrical company, a band using English instruments, another band with Chinese and a third with Tamil instruments. Several games are played, the most popular of which are rounders, football and ping-pong. It will be seen that every effort is made to keep the lepers actively employed and amused.

Admission to the Asylum.

During the past year over 80 per cent. of those admitted have come voluntarily, mostly at a comparatively early stage of the disease. The Chinese are very quick to recognize leprosy. Men, women and children are brought by their relations, who are quite willing to leave them in the asylum, provided that they are allowed to visit them occasionally. The great majority of the cases admitted at present are early cases and in these patients the prospect of cure is excellent.

The whole secret of the effective segregation of lepers consists in the provision of a suitable home where they will be happier and more comfortable than they are

in their own homes. Owing to the large number of voluntary admissions, the Kuala Lumpur asylum is now overcrowded, and it is the intention of the Government of the Federated Malay States to establish a leper colony on an excellent site, about fifteen miles from the town. A large area is available, and employment will be found for all able-bodied inmates. It is hoped that the colony will be to a considerable extent self-supporting.

Cost of the Tai Foong Chee Treatment.

The *Hydnocarpus anthelmintica* nuts and *Cannabis indica* seeds have formerly been purchased locally, from Chinese druggists, at a cost of 30 dols. a picul (133 lb.), or threepence per patient per month. Arrangements have now been made to purchase the chaulmoogra nuts in larger quantities from the Siam Industries, Ltd., Bangkok, Siam, at a cost, including freight, of 16 dols. a picul. This will bring the cost down to about twopence per patient per month. I am informed by the manager of the company that only a small proportion of the crop of these nuts, which ripen about September in Burmah, is gathered. The demand for the nuts for medicinal purposes is not large, and the systematic collection of them does not pay. It is desirable that the regular collection of the *Hydnocarpus anthelmintica* nuts should be undertaken by the Burmese Government. An ample and properly graded supply could be thus ensured for use throughout the Empire. I have had inquiries from the medical officers of leper asylums in many parts of the world, as to where they can procure the *Hydnocarpus anthelmintica* nuts, and it would be of great assistance to those interested in the cure of leprosy, if a depot could be established, preferably in London, where the nuts could be obtained regularly and at a reasonable rate. There seems to be no reason why, in tropical countries, the trees should not be grown in sufficient quantities to ensure a local supply. There are about a hundred of these trees in the Government experimental plantations near Kuala Lumpur; they are about three years old, and are strong and healthy. Instructions have been given for the planting of ten acres with *Hydnocarpus anthelmintica*.

Advantages of the Tai Foong Chee Treatment.

(1) The whole nut is used. It is possible that in the extraction of the oil, some especially valuable part of the nut may be left behind.

(2) The mixture is palatable and is taken twice daily without the least inconvenience. It is very popular with the lepers.

(3) It is inexpensive, costing only threepence per month for each patient. When systematic collection of the nuts is carried out, this will be considerably reduced.

(4) It is as easily taken by women and children as by men, which is not the case with the various forms of injection, all of which are necessarily somewhat painful.

(5) No skill is required in its administration, the crushing of the kernels and seeds, the preparation of the mixture and the actual dosing, all being done by the lepers themselves.

(6) No instruments of any kind are necessary.

(7) There is a great saving of time. Three hundred and fifty lepers receive their dose in half an hour, and each dose is registered.

(8) The general physique of the lepers is improved by the treatment; in nearly all cases they gain strength and put on weight. There is no doubt that the oil contained in the chaulmoogra nuts and hemp-seed when taken by the mouth acts as a food.

(9) Reactions are more easily controlled than is the case with treatment by injection; and incidental lung and kidney ailments, which frequently occur during the injection treatment, are conspicuous by their absence.

The following photographs show four cases, before and after treatment, by the Tai Foong Chee method:—

FIG. 1*a*.—*Ow Swee Yew*, aged 19. Five years a leper. Before treatment.
Has raised patches on face and forehead. Nose is misshapen and left ear swollen. Has ulcerated nodes on arms and hands. Stumps of fingers ulcerated. Physical condition poor and expression of face miserable.

FIG 1*b*.—*Ow Swee Yew*. After eleven months' treatment.
Patches on face and forehead have disappeared. Nose is normal and swelling of left ear is reduced. Ulcers on finger stumps, hands and arms have healed, leaving scars only. The improvement in facial expression and physical condition is remarkable.

FIG. 2*a*.—*Ah Chun*, aged 18. Fourteen years a leper. Before treatment.

The left ear, nose and mouth are swollen and distorted. There are nodes on the lower lip, cheeks, chin and neck, also patches on wrists, right hand and arms. The facial expression is mask-like and miserable.

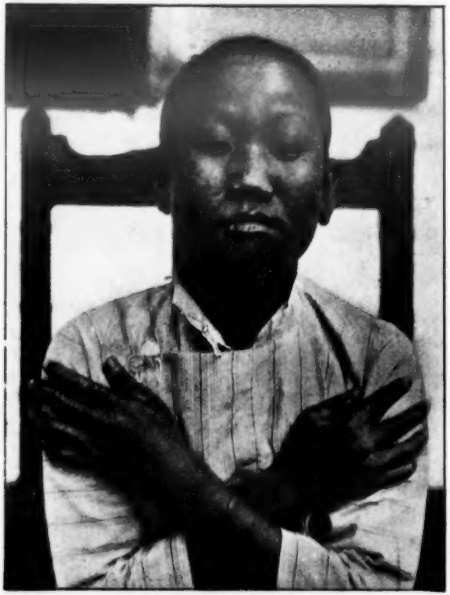


FIG. 2*b*.—*Ah Chun*. After one year's treatment.

The upper part of the face and the neck are practically well. The nose and mouth have almost regained their normal shape. Nodes on lower part of face are rapidly disappearing. The patches on hands and arms are visible as scars only. The facial expression and physical condition have much improved.

FIG. 3*b*.—*Tan Chai*. After one year's treatment. There are now no signs of leprosy.

FIG. 3*a*.—*Tan Chai*, aged 34. Three years a leper. There are raised and discoloured patches all over the skin of the face and forehead. The nose and lips are swollen. The chest is covered with patches and there is active ulceration on the fingers of the left hand

FIG. 4*a*.—A Chinaman, aged 50. Four years a leper. Before treatment.
Has nodes, raised patches and general swelling all over the face and ears. The skin of both hands is swollen and discoloured and there are large patches on both arms. The expression of the face is mask-like and miserable.

FIG. 4*b*.—The same case after eight months' treatment. All lesions have disappeared and the skin is healthy. The facial expression has entirely changed and is now quite cheerful.

ERRATA.

Proceedings of the Royal Society of Medicine, 1925, vol. xviii, Section of Tropical Diseases and Parasitology.

Page 55. In heading, for "Shown by H. W. Fantham, D.Sc.," read "Shown by H. B. Fantham, D.Sc."

Page 55, par. 3, line 2, for "twice" read "two."

Page 55, par. 6, line 1, for "derived from" read "parasitic in."

Section of Tropical Diseases and Parasitology.

President—Sir WILLIAM T. PROUT, C.M.G., O.B.E., M.B.

Case of Kala-azar in a Child treated with Intravenous Sodium Antimony Tartrate. Death. Microscopical Examination of the Various Viscera.

By LEONARD S. DUDGEON, C.M.G., C.B.E., F.R.C.P.

K. B., AGED 2 years 2 months at time of death. Father, N.C.O. British Army, mother, English. Child born in England. Breast-fed infant.

History.—In Malta from three months old to six months. In Singapore from six months to two years of age. Illness began at Singapore at the age of 1½ years. In St. Thomas's Hospital for four months until September, 1925, when the child died.

First symptoms of illness, malaria and dysentery. In hospital at Singapore for ten days and then invalided home to England.

Blood was examined in hospital at Singapore with the following result: Red cells, 3,000,000 per c.mm.; hæmoglobin, 25 per cent.; colour-index 0·4; leucocytes, 3,000 per c.mm.; megaloblasts numerous. No parasites seen.

Condition on Admission to St. Thomas's Hospital (under the care of Dr. R. C. Jewesbury), May, 1925.—Infant found to be lethargic, very emaciated, and very anæmic. Skin very pallid, but of a darkish colour. Chronic dermatitis over body, but especially over left arm. Abdomen very tense and protuberant. Spleen very firm to the touch and extended about 2 in. below umbilicus and for some distance across the median line. Liver extended to the midway junction between costal margin and umbilicus. Prominent veins were seen in the abdominal wall. No glandular enlargement found (see post-mortem report). The urine normal.

During June, 1925, blood and mucus were found in the stools, and diarrhœa was very severe. Sickness occurred, also actual vomiting. The child looked very ill and restless, and suffered from frequent bronchial attacks. Always took food badly except carbohydrates. Towards the end of August the child appeared much better, but died suddenly on the night of September 2, a few hours after an intravenous injection of antimony.

Weights.—On admission, May 5, 1 st. 8 lb.; June 6, 1 st. 6 lb.; July 14, 1 st. 6 lb.: August 14, 1 st. 6 lb.; September 1, 1 st. 6 lb.

Blood Examination, May, 1925.—Red cells, 2,320,000 per c.mm.; hæmoglobin, 36 per cent.; colour index, 0·7; leucocytes, 2,000 per c.mm.; polymorphonuclears, 32 per cent.; small lymphocytes, 51·5 per cent.; large lymphocytes, 5·5 per cent.; large hyaline, 10·0 per cent. One megaloblast and four normoblasts seen. Polychromatophilia seen. No malaria parasites found, and no Leishman-Donovan bodies found in smears of centrifugalized vein blood.

I punctured the spleen on May 22, and large numbers of Leishman-Donovan bodies were found in the splenic tissue, both intra- and extracellular, but especially in the large mononuclear cells. Wassermann and Sachs-Georgi reactions negative. No ova or parasites found in intestinal blood and mucus. Smears examined for Leishman-Donovan bodies from the intestinal blood and mucus, but without success.

TREATMENT.

I had to give all the intravenous injections of sodium antimony tartrate to this child under an anæsthetic, because he was very irritable and the veins were very mobile as they had no subcutaneous tissues to support them. The time

taken over the anæsthesia and the injection was very short, so that no inconvenience was caused during the whole period of treatment. Atropine $\frac{1}{100}$ of a grain was given before the antimony injection each time. Unfortunately, the child was unable to withstand the antimony treatment well. Even the doses employed caused sickness and cough about two days after treatment. The course of antimony treatment was as follows:—

Date	Strength of antimony	Amount injected
May 25	1 per cent.	0·5 centigramme
,, 27		1·0 ,,
,, 29		1·5 ,,
June 26		1·0 ,,
,, 29		1·0 ,,
July 1		1·25 ,,
,, 3		1·25 ,,
,, 6		1·0 ,,
,, 8		1·25 ,,
,, 10		1·0 ,,

From this date until August 26 the injections were given about every third or fourth day. The amount injected was 1·5 cg. of a 1 per cent. solution. On August 29th and September 1st, 2 and 3 cg. were injected.

Dimol was given to allay the diarrhœa, and various other forms of treatment were employed, as this condition was very exhausting to the patient and very resistant.

POST-MORTEM EXAMINATION. MADE WITHIN TWELVE HOURS OF DEATH BY DR. A. L. URQUHART.

Muscles of abdominal wall very flabby and muscles generally soft.

No fluid in pleural sacs.

Lungs.—Right weighed $4\frac{1}{2}$ oz., and left 4 oz. They were pale, but otherwise normal.

Pericardium contained 2 oz. of pale, straw-coloured fluid. Heart weighed $2\frac{3}{4}$ oz. Muscle, pale. No valvular lesions. Wall of left ventricle was $\frac{1}{2}$ in. thick. No clots in the heart. Blood in vessels fluid, showed no sign of clotting; very pale.

Liver weighed 29 oz.; pale, firm and tough. Contained no free iron.

Spleen weighed 16 oz.; was red and tough. There was an area on the outer surface which showed marked perisplenitis about 2 in. square, the seat of the splenic puncture.

Pancreas pale and firm.

Adrenals very small and very thin, leaf-like structures. Not pigmented.

Kidneys pale, not enlarged; no other changes seen. No naked-eye changes in the *intestines*.

Great enlargement of *lymph-glands*, which were found to be hæmolymph in structure. This enlargement was widespread.

Bone-marrow tough and of pale pink colour.

MICROSCOPICAL EXAMINATION.

Liver.—No free iron present. A patchy cirrhosis occurred with increase of connective tissue in portal and hepatic areas. Great increase of large mononuclear cells both in liver sinuses and in connective tissue of liver. Liver cells contain some yellow-brown granules, but no parasites. Liver sinuses also distended with red cells. Large mononucleated cells packed with parasites, and as these cells reach a very large size the number of engulfed parasites in the cells is very considerable.

Spleen.—Malpighian bodies diminished in number and small in size. Great distension of splenic sinuses with blood and very great phagocytosis of red cells by large mononuclear cells in the sinuses. Marked fibrosis and perisplenitis and considerable diminution of unstriped muscle. Marked fibrosis in areas and thickening of the vessel walls. A few foci of polymorphs scattered about. Plasma cells abundant, and large mononuclear cells in sinuses and in connective tissue abundant.

Large mononuclear cells in fibrous tissue packed with parasites, while the large mononuclear cells in the sinuses showing this phagocytic reaction are far less numerous. The parasites are also cell free. There is old blood-pigment scattered through the splenic tissue, which gives the free iron reaction.

Kidneys.—Tubal degeneration very marked. Cells swollen, distorted, and a-nuclear. Glomeruli and blood-vessels show no changes. No endothelial cell activity in the kidneys, and no parasites seen.

Heart Muscle.—Some fatty change present. No endothelial cell activity, and no parasites seen.

Adrenals.—Very little lipoid substance in cortex and very little of the medullary tissue left. The surrounding fatty tissue largely consists of small fat globules in large cells with eccentric nuclei as is seen in the cells of the fatty glandular tumour. No endothelial cell reaction and no parasites seen in the gland.

Lungs show an early stage of chronic pneumonia with no acute inflammatory changes. Mononuclear cells containing the usual pulmonary pigment abundant. Many alveoli collapsed. No parasites seen, and no foci found of large mononuclear cells in the connective tissue framework of the lung.

Hæmolymph Glands.—Scattered free iron reaction present. The small granules are chiefly intracellular. The reaction is only slight, and is almost confined to the sinuses. The sinuses are very distended and show abundance of blood with phagocytosis of red cells by the endothelials. Large mononuclear cells packed with parasites are very numerous in the glandular tissue, while this form of phagocytosis in the sinuses is extremely slight. Phagocytosis of red cells and parasites is observed in the same cell.

Films of the *bone-marrow* show masses of parasites in large mononuclear cells, and also cell free.

Intestines: Duodenum.—Large mononuclear cell reaction in tissues of mucous coat showing well-marked phagocytosis of parasites.

Ileum.—Large mononuclear reaction in mucous and submucous coats very extensive. Villi enlarged with swollen ends, and show masses of these cells packed with parasites. Mononuclear cell reaction diminishes as the submucous coat is approached. These large mononuclear cells are granular seen under low-power objectives owing to the intense phagocytosis of parasites. There is necrosis of surface epithelium of the villi, but not beyond, which can be readily explained by post-mortem degeneration, more especially as bacteria are numerous in this area. The large mononuclear reaction is present to the greatest extent in the mucous coat, and has not been observed in the muscular coat.

The following demonstrations were also given, and specimens shown:

Captain H. J. BENSTED: Serological investigations with *Bacillus pestis.*

Captain J. S. K. BOYD, M.B., R.A.M.C.: The Anatomy of *Loxotrema ovatum.*

W. BROUGHTON ALCOCK, M.B.: (1) Ringworm of Nails; (2) Two species of *Epidermophyton*; (3) Eosinophilia and *Filaria perstans.*

Major C. J. COPPINGER, M.B., R.A.M.C.: Dark-ground Methods of Illumination.

Captain GORDON CHEYNE, R.A.M.C.: (1) Methods of Sanitary Propaganda; (2) An Easily Portable Concentrated Ration.

Major S. ELLIOT, R.A.M.C.: Exhibits and Identification of Harmful Colouring Matter in Food.

Miss C. L. T. LUCAS: *Endamœba blattæ* from Intestine of Cockroach (*Blatta orientalis*).

Lieutenant-Colonel W. P. MAC ARTHUR, R.A.M.C.: Egyptian Mosquitoes.

Lieutenant-Colonel H. MARRIAN PERRY, R.A.M.C.: Histopathology of Lymphatic Glands in an early case of *Trypanosoma gambiense* infection.

Sir LEONARD ROGERS, C.I.E., M.D., F.R.S.: Maps and Diagrams illustrating the Relationship of the Incidence of Leprosy, Tuberculosis, Pneumonia and Smallpox to Climate in India.

J. GORDON THOMSON, M.B.: Malaria Films.

Dr. GERALD DE M. RUDOLF: Series of Blood-films illustrating experiments with *Plasmodium vivax* of Malaria in Blood taken from General Paralytics.

[*March* 11, 1926.

Pseudoparasites in the Fæces of Man.

By J. Gordon Thomson, M.A., M.B., Ch.B.

(*Director of the Department of Protozoology, London School of Hygiene and Tropical Medicine.*)

It was originally intended to deal with the whole subject of pseudoparasites of man, but a short survey of the literature soon showed that this was impossible in a communication of this character. Justice could not be done in the short time allotted to a study of all the anomalies, fallacies and puzzles which might be encountered in man. A substantial and well illustrated text-book would more fully meet the case. It is with regret, therefore, that the difficulties encountered in the examination of the blood, a subject dealt with by Balfour (1911) in what might be considered a classic communication, have been omitted.

In this paper it is intended to review shortly some of the more important pitfalls ever ready to trap the inexperienced in the examination of human fæces for the evidence of parasites. In the use of the microscope there is without doubt no more difficult art to be acquired than the ability to interpret all the objects, protean in their character, met with in fæcal examination. Trained zoologists and pathologists acquire their skill and special knowledge of microscopical technique over a period of many years; on the other hand, it can truthfully be stated that any short course in parasitology is only an introduction to the subject, and the student can only attain the desired degree of efficiency after years of travail and the perpetration of numerous blunders. This statement is based on personal experience.

Now it may be asked why this particular work is considered so difficult, and whether the training obtainable in any good school is not sufficient to enable the student to recognize the human intestinal parasites. The answer to these questions was rather aptly stated in a recent review in the *British Medical Journal;* that the bulk of human intestinal excrement enters the mouth in the first instance in the shape of vegetable or animal food, which may be of the most diverse kinds and contain a multitude of components.

The main essential for this work, other than a knowledge of the true parasites of man, is the ability to recognize the following: (1) The parasites of other animals ingested with the food; (2) small free-living animals; (3) coprozoic organisms; (4) organisms derived from the reagents used in the examination of the suspected material; (5) human intestinal cells; (6) vegetable and animal cells; (7) mechanical artefacts such as air bubbles under the cover-slip.

(1) Parasites of Other Animals Accidentally Ingested.

In this category it is not intended to place those parasites which Pavlovsky (1925) has so aptly called xenoparasites. These are true parasites which have accidentally found their way into the wrong host, in which, however, they continue to live, e.g., the tape-worm *Dipylidium caninum*. As a converse the term "pseudoparasites" is applied to those which, while they may be true parasites of some animal, are capable of passing through the intestine in an unchanged condition. This is well exemplified by the two fish coccidia *Eimeria sardinæ* and *Eimeria clupearum*, which can be cooked, eaten and passed through the alimentary tract of man more or less in their original state. Indeed, these two coccidia have been described as true parasites of man under the names of *Eimeria oxyspora*, *Eimeria snijdersi* and *Eimeria wenyoni*, and it was only recently that they were identified with the fish coccidia (Thomson and Robertson, 1926).

As interesting examples of this class of error the three following instances may be chosen. In 1911 Kofoid and White discovered in the fæces of man ova of a worm, which was named *Oxyuris incognita*, and these Sandground (1924) was able to prove to be merely the eggs of *Heterodera radicicola*, an infestant of potatoes and certain

vegetables. In 1924 Faust found in the fæces of a Chinaman minute oval bodies, which turned out to be spores of a myxosporidian derived from fish. Thirdly, some little time ago a curious body was detected in the fæces of a patient in the Hospital for Tropical Diseases. This body was spindle shaped, and corresponded closely to the sporocyst of *Monocystis agilis*, the gregarine of the earthworm.

(2) Small Free-living Animals.

According to Faust (1924) these are most commonly found in children, who are apt to put earth in their mouths. He reports the presence of the cabbage worm and the hair snake in human fæces. In a stained film, also from human fæces, the same author found the embryo of a small, edible, viviparous snail. Khalil (1921) reported the finding of the eggs of mites, which afterwards hatched out. These were identified by Mr. Hirst as *Aleurobius farinæ* and *Glycyphagus* ? sp. Mites have also been reported in the human fæces by Westphalen (1924) and Wertheimer (1925). Senior-White (1919) found beetles in the intestine of a Sinhalese boy in Ceylon, which were identified as *Onthophagus bifasciatus*. This author points out that these attacks seem to be confined to children between the ages of three to eight years. The eggs of flies laid on food sometimes hatch out and develop into larvæ in the body, from which they may be evacuated as living maggots. These may produce irritation but are usually harmless. Dr. Robertson in a private communication mentioned a case of an adult in Scotland, living in camp under somewhat primitive conditions, who passed an earwig.

According to Hickey (1920) the eggs of free-living and earth nematodes are often deposited on green vegetables that are eaten uncooked. These eggs may appear in the fæces, disappear after a short interval and are what Hickey termed "incidental" parasites. It might be noted here that on two occasions in Egypt the author found mites in fixed and stained films from dysentery cases.

(3) Coprozoic Organisms.

Coprozoic organisms develop in old specimens or cultures of fæces, and constituted in the past a fruitful source of error, especially in the diagnosis and recognition of the parasitic protozoa. It is not intended to review here the numerous genera and species of free-living organisms, which might be encountered as accidental contaminations of human fæces; these are now dealt with in most of the text-books on parasitic protozoa. The best method of avoiding errors arising from this source is to examine the fæces as soon as possible after the stool has been passed. Lynch (1922) encountered fresh-water algæ and diatoms in fæcal cultures.

(4) Organisms Derived from Reagents.

It is a common practice to use normal saline or distilled water to emulsify specimens of fæces for examination. Ciliates, flagellates, amœbæ, rotifers, and free living nematodes of microscopic size may occur in large numbers in the diluting fluid.

Two examples which occurred recently may serve to illustrate this. First, a specimen of fæces was sent home from India in which were numerous ciliates morphologically identical with *Nyctotherus faba*. The sender was advised by letter to investigate his reagents, and, to his surprise, he found his distilled water contained a heavy crop of these ciliates. Secondly, while investigating the amœbæ of the cockroach certain flagellates were encountered in preparations of the guts of these insects. These flagellates were eventually traced to the normal saline bottle, which had been left unstoppered on the bench. As it turned out, however, certain parasitic organisms were also present in the cockroach intestines, for, after freshly prepared saline had been sterilized by boiling for some time, they were still present in the smears of the gut contents.

(5) Human Intestinal Cells.

In a study of the fæces there is possibly no more difficult problem to master than the various altered body cells which occur in pathological conditions of the large and small intestine. Most, if not all, of these cells are in various stages of nuclear and

cytoplasmic degeneration, and it is only by prolonged and careful study of stained and unstained specimens that the worker can familiarize himself with their appearances. The use of wet fixation and staining with the iron hæmatoxylin method may produce in these intestinal cell-exudates remarkable nuclear and cytoplasmic figures, and, when chromatolysis has taken place, their nuclei may produce very close imitations of the nuclei of the human entamœbæ.

The plate of cells drawn from films of bacillary dysentery stools probably indicates more clearly than could any description the diverse appearances encountered in these altered body cells (*vide* Plate, p. 17). Pus cells, i.e., polymorphonuclear leucocytes, have frequently been mistaken for cysts of the amœbæ of man. It should be remembered that these cells may often ingest red blood-corpuscles. Macrophage cells, derived originally from the reticulo-endothelial system of cells, are often mistaken for amœbæ. Blood-clots and strands of mucus have been diagnosed as parasitic worms.

(6) Vegetable and Animal Cells introduced in the Food.

Faust (1924) states that starch grains may be confused with cysts, but that their eccentric pole and opaque substance rule them out. He also says that of all the vegetable cells which the clinicians in China have found the most confusing pollen grains are the worst. These are round, oval and elongated, and are frequently of the same size as helminth ova. Their contours are pitted, regular, or papillose, and if rolled over in most cases they are found to be flattened with a rounded contour on one side only. Yeast cells, blastocysts, and other fungus growths are common.

Very common constituents of the fæces, present in the majority of stools, are certain vegetable spores, which are rather reminiscent of golf balls in appearance. Two distinct varieties occur, one with its surface covered with raised plaques like a tortoise-shell, and the other with regularly arranged depressions, like inverted cones, dotted all over. These spores are spherical, and, as they are brown in colour, it is quite conceivable that confusion might arise between them and helminth ova. In optical section they are seen to have a very thick outer wall, in which can be determined the conical depressions or the grooves between the raised portions mentioned above, a thinner inner wall and a more or less homogeneous content.

Vegetable cells and spirals, undigested or partially digested muscle fibres, may simulate parasites. According to Faust parenchyma cells of the *Cucurbitaceæ* may at times be mistaken for helminth ova, and the stone cells of such fruit as the pear may look like *Tænia* eggs. According to Cammidge (1914) banana débris may simulate *Hymenolepis nana*, and Emrys-Roberts (1914) figured banana débris which was not unlike segments of a tape-worm.

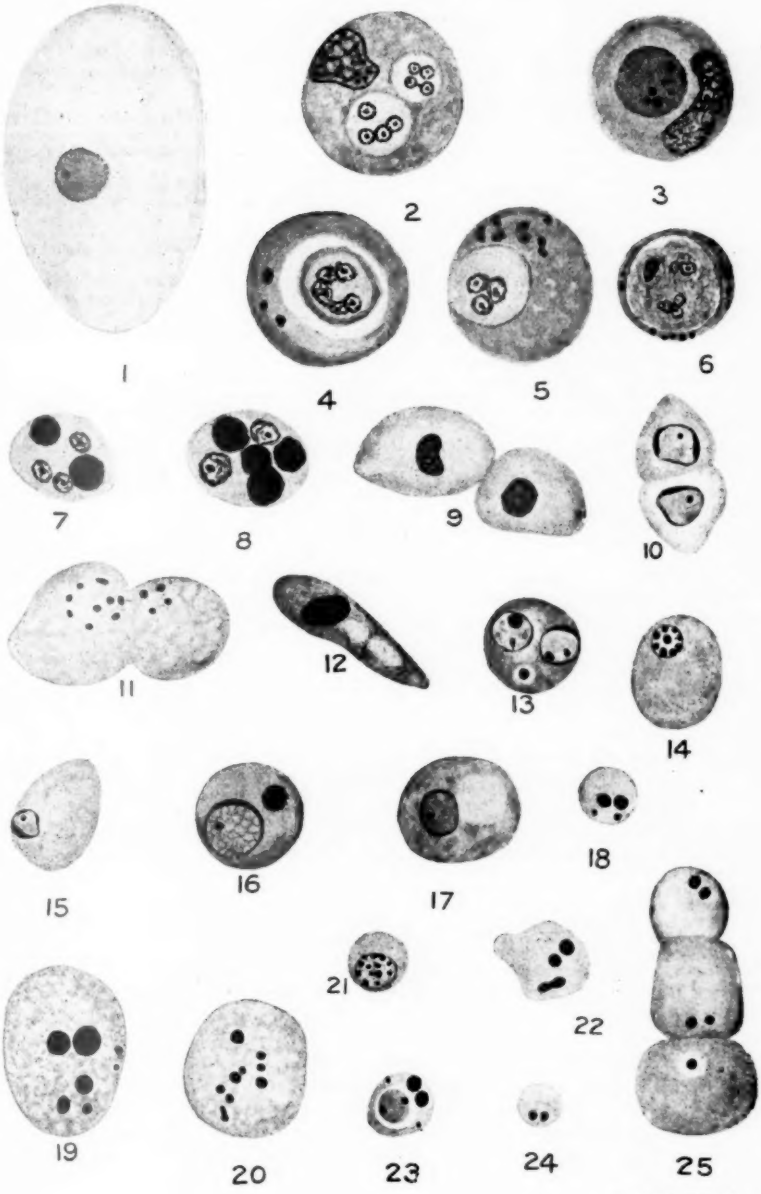
A most important paper on this subject is that of Royal (1908), but, unfortunately, it has not been possible to consult this in the original. Royal states that many cases are on record of the cells of oranges and lemons having been diagnosed as trematodes, and of celery fibres having been confounded with *Ascaris oxyuris*, *Ankylostoma*, or *Dipylidium*. Fragments of onion and portions of dates, oatmeal, rhubarb and pine-apple are liable to misinterpretation. The author experimented on himself with a large number of special diets.

(7) Mechanical Artefacts.

This branch of the subject may be dismissed in a few words, the majority of such artefacts being fairly obvious, but it is almost axiomatic that every beginner has to blunder at least once over an air bubble and over an oil globule. A peculiarly misleading form of the latter is that in which fatty acid crystals are forming over the surface.

Conclusion.

A complete list of all the fallacies and puzzles which may be encountered is impossible, for obvious reasons; but time, experience and patience usually clear away all the difficulties. The best advice which can be given to a beginner at this work is to insist on getting the specimen for examination as soon as possible after it has been passed, to avoid its possible contamination during transit, and to see that the necessary reagents are themselves free from organisms.



J. G. Thomson, del.

Cells in Bacillary Dysentery. Magnification = 1,400 approx.

Description of Plate.

All the figures are drawn from cases of bacillary dysentery. The films were fixed wet in Schaudinn's solution, and stained by Heidenhain's iron hæmatoxylin method. Magnification is approximately 1,400 diameters.

Fig. 1.—Large squamous epithelial cell.

Figs. 2, 3, 4 and 5.—Macrophage cells derived from the reticulo-endothelial system. Fig. 2 shows a cell which has ingested two polymorphonuclear leucocytes, the nuclei of which are seen in vacuoles. Fig. 3 shows an ingested cell, the nucleus of which has broken up into small spherical masses. In figs. 4 and 5 the nuclei of the macrophages have broken up by chromatolysis.

Fig. 6.—This type of cell is very common. The cytoplasm is collected into a narrow band round the periphery, suggesting a blastocyst. There is a large vacuole in the centre with a phagocytosed polymorphonuclear.

Figs 7 and 8.—Polymorphonuclears with ingested red cells.

Fig. 9.—Two intestinal epithelial cells, still attached to one another, with their nuclei fairly well preserved.

Fig. 10.—Two intestinal epithelial cells showing early chromatolysis of the nuclei. Note that the chromatin collects at the periphery leaving a round mass in the interior. This is an early stage of nuclear degeneration and it may simulate the nuclear appearances of *Entamœba*.

Fig. 11.—Two intestinal epithelial cells in which the nuclear degeneration has proceeded further, and almost complete chromatolysis has taken place.

Fig. 12.—A more or less unaltered columnar epithelial cell.

Fig. 13.—A curious cell, very commonly found in the cell exudate of bacillary dysentery. It has two nuclei, both of which appear to be vesicular in character, but this is simply due to early degeneration, in which the chromatin collects in a semilunar fashion at the periphery of the nuclear membrane.

Fig. 14.—A plasma cell.

Fig. 15.—This may be a plasma cell with the nucleus at that stage of chromatolysis which causes the cell to look like an amœba.

Fig. 16.—This is another curious cell in bacillary dysentery. The nuclei of this vary in number. Note the vesicular appearance of the nucleus produced by early degeneration changes.

Fig. 17.—An epithelial cell in which the nucleus again simulates that of an amœba.

Figs. 18, 19, 20, 22, 23 and 24.—Various degenerated cells or parts of cells in which the nuclei have completely fragmented.

Fig. 21.—A lymphocyte.

Fig. 25.—A common feature in which several rounder degenerate cells are seen still adhering to one another.

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Section of Tropical Diseases and Parasitology.

President—Sir WILLIAM T. PROUT, C.M.G., O.B.E., M.B.

PRESIDENT'S ADDRESS.

Health Conditions in the Colonies.

By Sir WILLIAM T. PROUT, C.M.G., O.B.E., M.B.

I HAVE found it difficult to select a subject for this address, which is known as the "Presidential Address," because it seems to me to be an occasion on which one may depart from the more technical and scientific subjects generally brought up for consideration at the meetings of this Section. It has occurred to me that if I made a few general remarks upon the "health" conditions obtaining in the Colonies which combine to form a part of the great British Empire, upon the problems which confront us, racial, geographical and pathological, and the measures which are in use to deal with and to improve them, it might be of some interest to you. I am afraid that I shall have to do so very briefly and sketchily, for the subject is so vast that it cannot be adequately discussed within the limits of time at my disposal.

Some short time ago a great Exhibition closed, the greatest Exhibition which the world has ever seen, as has been said, and on that occasion the King sent a message of hope and good cheer for the future of all the Dominions and Colonies represented there. In that Exhibition were to be seen the products from all parts of the world which fly the Union Jack; coffee from Kenya, palm oil and kernels from the West Coast, cotton from Africa, sugar from the West Indies, spices and rubber from the East, gold and frankincense and myrrh, precious stones, in short, all varieties of vegetable and mineral wealth, developing and awaiting development. And I may add that as a counterpoise to this, in one section was shown a collection of tropical diseases, an illustration, perhaps rather strongly put, of the dangers awaiting those who venture out across the far seas to collect these treasures of wealth for the benefit of humanity.

I need hardly say that from my brief review will be excluded those immense areas which form the self-governing Dominions, who now solve their own problems. Nor shall I mention the great Indian Empire, which may safely be left in the care of that distinguished service, whose energy, resource and ability I learned fully to appreciate when I served on the Suez Canal and in Egypt during the early part of the war.

I shall confine myself, therefore, to considering health conditions in what are known as the Crown Colonies. It may be of interest to some of you at least if I mention generally how they are governed, and how general administration is carried out.

Theoretically, they are governed by the King through a Secretary of State, who is responsible to Parliament. In actual practice the work is largely done by the permanent officials, a body of men who, though often lacking in personal acquaintance with the Colonies, in time acquire a great deal of expert knowledge of their conditions. Locally, the King is represented by a Governor who, assisted by the advice of Executive and Legislative Councils, carries out local legislation and local administration. His power varies in different parts of the world: in some Colonies being nominal, and largely social, with a power of occasional veto, and in others forming the nearest approach to an autocracy which this twentieth century will permit of.

And this form of administration deals with all questions of high politics, of finance, of commerce, and of health and sanitation, and even of law and the Church. Now this is obviously not the place to criticize the administration of any Department of State, especially by one who is so intimately connected with it as I am. I have simply given an outline of how our colonial government is carried on, and I shall content myself later with inviting your attention to a change in point of view—a fortunate change, which, in my judgment, has, for a number of years past, been taking place in relation to the question of health.

If you will look at a map of the world you will observe dotted over it a large number of places coloured red, representing the British colonies or mandated territories. A further study will reveal the fact that these can be roughly divided into three groups, one group in the West, the West Indies, a second group in the East, represented by the Straits Settlements and Hong Kong, Ceylon, &c., and a third, and by far the largest, consisting of the colonies and territories of Tropical Africa. There are, in addition, a number of smaller colonies scattered about the Pacific, the Atlantic, and the Mediterranean, to which reference cannot be made. Let us look at these three groups and their problems of disease very briefly.

The West Indies may be used broadly to refer to Bermuda and the Bahamas on the north, extending down to British Guiana on the mainland of South America to the south; and the conditions—constitutional, political, financial, economic and sanitary—vary within wide limits. Some of the islands have a representative government which brooks little interference from this country, others have what may be described as pure Crown Colony government, namely, a Council consisting of an official and unofficial element, the latter being mostly nominated. Everywhere, however, the tendency is to demand a degree of elective representation which is gradually extending and will eventually have to be conceded. I merely mention these points because, upon the degree by which legislation can be controlled or guided, depends the health and sanitary progress of these colonies, and so far the evidence is not great that there exists an adequate public opinion or strong public realization in these colonies of the need for sanitary reform or an appreciation of health requirements as a basis for economic progress. And in some instances the financial conditions are such as to preclude much in the way of sanitary work. I am inclined to divide the West Indian Islands from a health point of view into those who have money and will not do anything, those who have no money and consequently are unable to do so, and those who have some money and do what they can.

As regards the conditions of medical services in the West Indies, they are very varied. The question of a uniform service was considered and recommended by the West Indian Medical Conference in July, 1921. At present, however, the difficulties appear to be insuperable, but it is an ideal to be aimed at, as it would tend to elevate the standard of the profession and thus assist in the creation of that public opinion which is so much to be desired. In two of them, British Guiana and Trinidad, well defined medical services exist, contented for the most part, capable and efficient.

An examination of the medical reports for these colonies reveals a state of health matters which is disquieting. It is a considerable time since yellow fever was a cause of mortality in the West Indies generally, and now, thanks to the work of the Rockefeller Foundation, this has practically disappeared in the neighbouring continents. One of the most interesting and graphic examples of the effects of systematic sanitary work connected with mosquitoes is the map showing the gradual shrinkage in the yellow fever area until it has almost reached vanishing point.

But in the West Indies you still find universally a high death-rate and a high infant mortality—that index of insanitary conditions. The causes obviously vary in different localities, but I have been much struck by the fact that everywhere the diseases which account for the greatest mortality are those referable to the gastro-intestinal canal, that is to say, not purely tropical diseases at all, but diseases due to

defective sanitation and to extensive soil pollution. Whilst in some colonies the majority of deaths are attributed to the single disease malaria, yet, if we add together those connected with the intestinal canal, we almost invariably find that enteric fever, gastro-enteritis, and ankylostomiasis together account for still more. The work of the Rockefeller Foundation in the West Indies in its various campaigns has shown definitely that while the incidence in man can be reduced by systematic treatment, yet, in the absence of proper sanitary measures, re-infection is so great that in a comparatively short period the prevalence of these diseases is as great as ever, and that if they are to be eradicated, measures to prevent soil pollution must advance *pari passu* with personal treatment.

If we now take a big stride across the Atlantic and place our foot on African soil we meet with very different conditions. In the West Indies we have long-established colonies which were at their zenith years ago; in Africa we have the beginnings of a huge Empire which has hardly been touched. When I first went out to Africa over 30 years ago, the colonies consisted of a bare fringe on the Coast, and it was unsafe to proceed more than a few miles inland. Now, everywhere, railways stretch for hundreds of miles inland, and steamers find their way along every navigable river. And as civilization brings these improved means of communication and transport, so are new diseases carried to communities previously free from them. Plague, formerly unknown in West Africa, is a comparatively recent gift from the East to the West, evidently having worked its way from the French possessions in the north, slowly along the coast. At Lagos it now appears to be firmly established, and recent information points to its spreading slowly up the main railway line to the huge centres of population in the interior.

The same holds good of the spread of trypanosomiasis; while communication was by foot or by canoe its area of infection was comparatively limited, but when I visited the Congo a year or two before the war, fresh centres of infection were being formed by the stern-wheelers with their live cargo, which penetrated everywhere.

And now from the north we are threatened with fresh means of invasion across the desert, owing to the establishment of paths of communication with French territories. A medical officer whom I saw the other day informed me that he had little doubt that relapsing fever was being introduced by that route.

Malaria is, however, the most prevalent disease of West Africa, and no doubt accounts for a very large mortality, inefficiency and suffering. Here, as in every endemic centre of malaria, the native children are almost universally infected and form the chief source of supply of infection. Few Europeans escape an attack of it at some time or other.

Much has been done in the way of prevention of spread of malaria by means of anti-mosquito work, but owing to the vast areas involved one must depend largely on personal protection, and, unless in special areas, it will be centuries before it can be eradicated.

Yellow fever is another disease which exacts a heavy toll in human life, especially among Europeans. It has been known as existing for many years, but recently special attention has been directed to it, and there can be little doubt that it is endemic in many parts. A Commission from the Rockefeller Foundation is now engaged in an inquiry on the spot, which it is hoped will throw light on some of the obscure problems connected with it.

Ankylostomiasis and other bowel diseases are prevalent, and here again soil pollution exists everywhere. You can invariably tell when you are approaching a native village by the fæcal odour which contaminates the air for about a quarter of a mile surrounding it. Progress here must be slow, and must proceed by way of education.

Before concluding my remarks on West Africa I will state an instance of the effect of the climate. I find that in one Colony among European officials 6,115 days

were spent on the sick list in 1923-24, and the percentage of sick to the average number of residents was 2·42. The average time that each person spent on the sick list during one year was 8·87 days. Can you imagine what would be the effect if in this country every working man, every clerk, every tradesman spent nearly nine days absent from work on account of illness?

Among the native officials the figures work out somewhat differently. Out of a much larger number of residents, 8,440 days were spent on the sick list, and the percentage of sick to average residents was only 0·89. There is obviously, then, some factor which renders the native more immune to the local diseases than is the European.

I should like to dwell upon this question of unhealthiness in West Africa and discuss how far the resisting power is affected and vitality lowered; how far it is affected by the question of food, the lack of vitamins and indifferent cooking; and to what extent residence in a hot, moist climate with a small diurnal and annual range of temperature predisposes to parasitic diseases; but I must hurry on and step across the "great divide" into East Africa.

There is as yet no direct communication by land between East and West Africa apart from the big caravan routes across the Sahara, and the points where the Belgian Congo touches on East African possessions. But to trek across by that route is a long and weary way, taking many months.

It is only quite recently that a homogeneous medical service has been established in East Africa, and it will be some time before its effect becomes evident. In addition, we have recently taken over greater responsibility in the way of Mandated territories.

Here again we find different conditions. East Africa is in direct contact with India, and is open to attack from that side, with the result that plague has become endemic. In Kenya, in spite of warning from the medical profession, insanitary conditions similar to those found in India have been allowed to grow up, and in the presence of vested interests are difficult to remedy. Nairobi, a town of only a few years' growth, is a striking example of the evils of lack of sanitary supervision and the absence of well-thought-out town planning.

Malaria, as in West Africa, is almost universally prevalent, and for the same reason, namely, the presence of a store of parasites in the children and the prevalence of varieties of anophelines. It does not appear to be of the same intensity as in West Africa, the reason for this being that there is probably a greater preponderance of healthy stations. Whether that is so or not, it has been found that officials can live with greater impunity for longer periods of time in East than in West Africa.

I have gathered the impression that quinine prophylaxis is less frequently carried out in East than in West Africa, and that medical officers are more divided in opinion as to its efficacy. This may also possibly be accounted for by the presence of more healthy stations. In West Africa the experience of medical officers is almost unanimous in favour of quinine prophylaxis. I also find that blackwater fever is fairly prevalent, and ask myself whether this is in any way connected with defective quinine prophylaxis and other anti-malarial protective measures.

Trypanosomiasis is one of the problems of East Africa, and as such has resulted in so great a mortality as to affect the labour supply. Twenty years ago, 300,000, or about one-tenth of the population of Uganda, died from this disease. Treatment is now much more effective, but knowledge of the tsetse fly and methods of prevention are defective, and it is hoped that the Commission of Inquiry will do much to throw light upon the problems of prevention which still require solving.

With such an extent of tropical country, extending from the source of the Nile in the north to Southern Rhodesia and Bechuanaland in the south, it is obvious that a complete review cannot be given; so we must hasten on.

Leaving Africa, which I have only briefly touched upon, we come in the East into an entirely different world, inhabited by a conglomerate people, with civilization

reaching back for thousands of years. Instead of the vast unpopulated areas with forests, swamps and deserts, we find densely populated areas, large overcrowded towns, with numerous races, religions and different mental outlook. Here, again, sanitary conditions have been permitted to grow up which are repellent to the present Western mind, but with which the native, more fatalistic perhaps, is quite content. This makes the problem more difficult of solution, but each colony is tackling it in its own way, and often very satisfactorily.

On the whole the average standard of general education and of intelligence is higher than that of the aboriginal African. We find, in Singapore, a College of Medicine with its professorial staff, in Ceylon a School of Medicine, and in Hong Kong a University, all doing excellent work and sending out workers to prevent and cure disease. The diplomas and lectures are recognized by the General Medical Council.

Malaria is again one of the prevalent diseases, but anti-mosquito work is energetically carried out in the Malay States, Ceylon and Hong Kong.

Some of the big towns, Colombo for example, are doing very good and encouraging sanitary work, though handicapped by the legacies from previous generations.

Other diseases which I have mentioned elsewhere, plague, ankylostomiasis, genito-intestinal complaints, &c., are also prevalent in the East. Infant mortality is high, but infant and maternity welfare centres have been formed, and their work is already showing good results.

Here, as elsewhere, the ravages of venereal disease are pronounced, and prominence has been given to it at the recent meetings of the Imperial Social Hygiene Congress. In dealing with it, however, we must always bear in mind the essential differences between the Eastern and Western mentality. If we forget this, progress will undoubtedly be hindered.

From this very superficial survey it will thus be seen that there are great problems of disease still awaiting the attention of not merely the medical profession but of the administrators and the executive.

I have endeavoured to emphasize the fact already known to you, that the diseases which cause the greatest inefficiency, suffering and mortality, are malaria, diseases due to soil pollution and its sequelæ, water pollution, fly production, &c., sleeping sickness in a limited area, plague and venereal diseases.

The problem of malaria control is by no means an easy one; in certain localities malaria can be dealt with, diminished and eradicated, but in the vast regions of some of our tropical possessions it will take years for radical measures to become effective, and dependence must be placed on personal preventive measures. While at first the control of it seemed easy, with increasing knowledge of the varieties and habits of mosquitoes, it has now become evident that continued research is called for, and we realize that for years to come its complete eradication is not economically possible.

The problem of yellow fever, as I have said, has been tackled with success in the West, and we hope that before long light will be thrown on its causation and incidence in West Africa. I need not further allude to trypanosomiasis.

The aggregate of diseases resulting from soil pollution exacts an even greater toll from the human race than does malaria. These diseases can only be dealt with by the same methods which have resulted in a slowly falling death-rate in this country. And as in this country it has only been possible to carry out sanitary improvement by educating the populace in the evils of insanitation, so it will be in the tropics. The habits of the natives of tropical countries, ingrained by custom and use, cannot easily be changed, hence education in elementary hygiene and active propaganda must be the first steps in the upward path. It is easy to make latrines, it is not easy to make an aboriginal population use them.

Syphilis, with its drain upon the infant population, is being systematically dealt

with, in certain parts of the world especially. In Uganda, under the very able guidance of Major Keane, much is being done to stamp out what is there almost a universally prevalent disease.

Plague and other diseases also call for comment, but time does not permit of my discussing questions relating to them.

In concluding these observations, I would invite attention to what must be regarded by us, as a profession, as a remarkable and pleasing change in the view which the laity and the executive are taking of this relationship to health problems in the tropics, and this in one special direction. Whilst mortality statistics can be appreciated, and an excessive death roll is always commented upon, it is only within comparatively recent years that the relationship of disease to EFFICIENCY, and the dependence of the latter upon health, have been realized. So far back as 1904, in a course of lectures in Elementary Hygiene which I gave, and which were subsequently published, I used the following words:—

"Health means capacity for work, capacity for work means money, money means the well-being of the individual—the ability to surround himself and his family with comforts, or even luxuries, and it also means the general prosperity of the community. Health means longer life, and consequently increased population. This implies increased capacity for production, and again leads to increased prosperity."

But this matter of efficiency in relation to health is not so easy to demonstrate as a death-rate. The Rockefeller International Board of Health has, however, definitely shown that on certain estates where ankylostomiasis is prevalent, the standard of work was higher in individuals who were treated and freed from ankylostome infection. I showed that in Jamaica the loss in sugar and other plantations from illnesses ran into thousands of pounds. It can be demonstrated that in tropical Africa, among the official population (originally passed as first-class lives for service in the tropics, be it remembered) the annual loss through absence from duty on account of illness—a good deal of which is preventable, as shown in the statistics—must cost the community hundreds of thousands of pounds, and to this we must add the loss of efficiency, which cannot be set down in black and white, but which precedes and follows definite attacks of illness, and which often exists without officials going on the sick list. A similar, if not more aggravated, state of affairs must be present among the mercantile community, though it is not possible to obtain such definite statistics. In the East a study of the morbidity and mortality statistics of rubber and other estates demonstrates the same thing, and in many places efforts are being made to modify this. In other words, there is a recognition of the fact that "health pays," and that it is an essential factor in economic progress. This view may not be entirely altruistic, but if it succeeds in applying a stimulus to sanitary progress, it must be regarded as altogether to the good. Everywhere, with some few exceptions, there is evidence of keenness among the medical officers of our tropical colonies as regards preventive medicine and sanitation, as contrasted with hospital work, which, however, is important, and must remain so for many years to come.

And among those in high places, whose duty and privilege it is to guide the destinies of our tropical colonies, there is now a whole-hearted recognition of the facts to which I have alluded, and a desire to further medical research and to aid sanitary progress. Let me give you a few quotations from recent reports. A Report was issued 1921-22 by the Hon. E. F. L. Wood, M.P. (who was then Under-Secretary of State for the Colonies, and is now Viceroy-Designate for India), after a very extensive tour in the West Indies, when he had opportunities of collecting information as regards the economic and health conditions in these localities. In this Report he makes the following statement:—

"The essential preliminary of development must, as I have shown, be a vigorous tackling of the problem of improving the health and sanitary conditions in the Colony . . . The high

mortality is largely preventable and is mainly due to the unsatisfactory sanitary conditions under which the population lives . . . On these vital matters public opinion, without which all Government and Municipal efforts must be greatly hampered, is uneducated and unformed. An extraordinary apathy prevails towards proposals for improving conditions. . . . I place the improvement of public health and the organized attack on tropical disease first in order of priority in matters in which Government can help."

In the Report of the East African Commission, presided over by the Hon. W. Ormsby Gore, M.P., the present Under-Secretary of State for the Colonies, with Labour and Liberal Members, very striking comments are made on the conditions of health. In connexion with the Medical Services, the following statement is made:—

"The recent economic development of East Africa has brought home to the authorities the immense importance of the provision of health centres. The soil of East Africa is amazingly fertile; the population is small. That is due, largely, to tribal warfare, to the slave trade, to epidemic and endemic diseases, to tribal customs, to the late war between the Allies and Germany on East African soil, and to the depredations of wild animals and the ravages of insect pests. A boom in an economic crop—cotton for example, presents in its wake a demand for native labour for crop production, for ginneries, for railway and harbour construction, for roads and for conveyance and handling. The shortage of labour becomes immediately an anxiety to the Government, the care of the natives becomes at once the responsibility of both private employers and the Government. We are convinced that the Governments now fully realize that the future of the country is dependent upon the care of the native population, the increase of its effective birth-rate, and, above all, the prevention and cure of disease. We found that every section of the community in East Africa is unanimous in demanding an increase in the provision made for medical services. Irrespective of motive the demand is sound and it must be satisfied."

Other references to this subject are contained in the following passages:—

"One of the great deficiencies throughout the East African territories is the absence of reliable vital statistics. It is extremely difficult to deal with problems of labour and native production in the face of the many conflicting estimates which are published from time to time. Statistics regarding the incidence of various diseases are inadequate, and the veterinary statistics are also capable of considerable improvement . . . We must confess to a feeling of disappointment at the small amount of money which is voted by the Imperial Parliament to Colonial Research." "We have already said that the basis of all efforts to eradicate and to prevent disease in East Africa must be a solid foundation of knowledge regarding sanitation and hygiene. Improvement in the outlook of the natives in these matters can be effected best by the provision of educational facilities."

And lastly, in referring to the question of finance as regards transport, it is said that:—

"We recognize that such a plan makes some demand on the British taxpayer for the initial period of the service of the loan. We feel that such a demand can be justified if only on the grounds of the moral obligation imposed on Great Britain for the development of its great tropical possessions."

While this is true of East Africa, the same thing can equally be said of many other of our possessions. In the West Indies the poverty-stricken conditions imply a moral obligation on the part of this country to help these dependencies. I would go somewhat further than the report of the East Africa Commission, and place health even before transport; for, unless the population can be increased by improving the health of the native community, the return is not likely to mature for many years to come.

In a speech delivered at Wembley, the present Secretary of State for the Colonies, Mr. Amery, laid special stress on a health policy in the following words:—

"The problem of development in Africa was, in the main, a human problem. It had to be carried through by the people of the country themselves, and at present the people of Africa were not in numbers, physique, or intelligence, capable of coping with the great task, and the duty of statesmanship lay in the physical, moral and intellectual development of the

people. They were beginning to realize more and more that African diseases and tropical diseases were not something inherent in a climate so much as inherent in the man and due to neglect, and eradicable. They who had to look at these matters from headquarters realized the increasingly important part that the medical services had yet to play in their whole scheme of administration in the tropics, and the increasing attention that they at headquarters were bound to devote to the medical aspect of the problem. In fact, they were more and more beginning to realize that the administration of the Empire as a whole, as well as the administration of this country, must be based on a sound health policy."

In the early part of this address I have outlined the methods of administration, but I have omitted to mention that on health questions there has been established for a number of years, first in connexion with Africa, but recently in connexion with the health of all the tropical colonies, an Advisory Medical and Sanitary Committee. Although I am a member of this Committee, I feel justified in claiming that it has been of considerable value in assisting to advise on many of the sanitary and medical problems which have arisen.

In a public speech recently delivered by him, Mr. Amery has foreshadowed the formation of a small Medical Department of the Colonial Office. If this project is carried out—and I understand its accomplishment is dependent upon the views of the Treasury—it will be one of the greatest steps which has been taken for many years towards a complete understanding of the many and varied health problems which from time to time come up before the Colonial Office, and I am convinced that the highest benefit will result from the establishment of such a department.

On this note of optimism I conclude my remarks. Much has been done in the past, and the danger spots of the Empire are slowly being cleansed; but much remains to be done, and with public attention and public opinion riveted on this important subject, a new era of hopefulness must be opening up before us.

Section of Tropical Diseases and Parasitology.

President—Sir WILLIAM T. PROUT, C.M.G., O.B.E., M.B.

Some Aspects of Therapeutic Malaria.

By G. DE M. RUDOLF, L.R.C.P., M.R.C.S., D.P.H., D.P.M.

THE therapeutic use of malaria has provided an opportunity for the study of this disease, and in this article a few of the recently-made observations will be briefly described, so that these may be compared with the naturally-acquired disease.

Benign tertian malaria is the type most commonly employed as a therapeutic agent. Malignant tertian malaria is too dangerous, and both the malignant and quartan forms are less readily influenced by quinine (Gerstmann [1]). For this reason only the benign tertian form will be considered in this paper.

IMMUNITY.

Before passing on to the inoculation of the patient, the question of immunity should be discussed. "Natural" immunity apparently exists in some cases. Pijper and Russell [2] were unable to infect six South African natives with malaria. A seventh underwent three mild paroxysms only. Gerstmann [1] records five patients to whom five injections, some intravenous, of malarial blood were given. In no case did malaria follow any of the inoculations. A patient at Claybury Mental Hospital, who had never been out of England, was inoculated on four occasions. Malaria never developed, but a parasite was found on one day only, following one of the injections. Of course, the cases which do not develop malaria after the first or second injection, but do so after the succeeding one, cannot be regarded as immune.

In order to determine whether an immunity to artificially inoculated malaria can be established, a series of inoculations, extending over two years, was carried out at Claybury Mental Hospital, under the direction of Colonel S. P. James. The results of these investigations showed that when one strain only of *Plasmodium vivax* was utilized an immunity to this strain develops. The degree of the immunity became more marked as the number of inoculations in each patient increased. In some cases an immunity was established after one attack of malaria, but for a complete immunity to be produced more than one series of febrile paroxysms was usually required. One patient, who was immune to blood inoculation, was inoculated from mosquitoes infected with the same strain. No fever developed, but parasites were found in the peripheral blood for four days. Two patients, both partially immune to this strain, were now inoculated with infected blood from a new strain of parasite. Both developed typical malaria, but with spontaneous cessation of the fever. Two further cases, one immune to blood-inoculation with the old strain, and the other partially immune, were inoculated by means of mosquitoes infected with the new strain of *Plasmodium vivax*. Both developed typical malaria, although in the first patient the paroxysms ceased spontaneously after the sixth day of fever. The longest period between any two inoculations in any one patient was 17 months.

STRAINS OF PLASMODIUM VIVAX.

Besides the difference in immunity and the height of the fever, with different strains of parasite, the question of the prevalence of gametocytes is of great importance. In a country such as England, in which the anopheline mosquito is common in most rural districts, it is necessary to screen the patients when gametocytes are present in the blood-stream. It would, therefore, be of extreme value if a strain of parasites could be bred in which gametocytes were absent. This is what appears to have been accomplished in Austria.

Barzilai-Vivalders and Kauders [3] report that no gametocytes have been found in

either of the two strains of *Plasmodium vivax* during the past two years. No oöcysts or sporozoites could be found in anopheline mosquitoes fed on patients infected with these strains, and none of six patients bitten by such mosquitoes developed malaria. This absence of gametocytes did not always occur, for Doerr and Kirschner [4] found this stage of the parasite in the earlier passages of the strains, although they observed a poverty of them from the thirty-third passage.

Preservation of Parasites.

Several methods have been suggested for the preservation of the parasite alive in malarial blood, but a method recorded by Gerstmann [1] would appear to be the most satisfactory. Inoculation has been successful with blood preserved for ninety-two hours by this method. A failure is rarely obtained from forty-eight to seventy-four hours after withdrawal of the blood from the donor. The malarial blood, previously defibrinated, is placed on blood-agar (three parts of defibrinated blood to one part of agar) and kept at a low temperature. Should the serum become cloudy, the specimen must be thrown away. Mühlens and Kirschbaum [5] have preserved the parasites alive for seventy-two hours on ice, and I have sent frozen defibrinated malarial blood 170 miles by post with a resulting successful inoculation.

Incubation Period.

The incubation period of artificially inoculated malaria is very variable.

In fifty-three cases of mosquito inoculations, chiefly collected from the literature, the first rise of temperature occurred from seven to twenty-five days after inoculation. In fifty-two of these cases parasites were first found from seven to thirty days after inoculation. Subcutaneous blood inoculation gives an incubation period of from one to thirty-six days, but intradermal inoculation produces a longer period. Intramuscular inoculation produces about the same duration of the period as does subcutaneous inoculation. In twenty-eight cases, the length of the incubation period varied from six to twenty-three days. With intravenous inoculation of infected blood, a considerable reduction of the period occurs, the duration varying from one to nineteen days, but usually being from three to eight days.

The length of the period is apparently related, to some extent, to the number of parasites injected. Experiments which I have carried out, using subcutaneous inoculation of malarial blood, demonstrate this. The following table shows the results obtained:—

Series No.	Patient's No.	Sex	Dose in c.c.	In days: Parasites first found	In days: First temperature to 101° F.	In days: First temperature to 103° F.
1	1	M.	2	17	17	17
	1A	M.	2	13	9	9
2	2	M.	2	14	11	13
	2A	M.	2	16	19	19
3	3	M.	1·5	7	7	10
	3A	F.	1·5	5	7	8
4	4	M.	3	19	21	22
	4A	F.	3	19	18	18
5	5	M.	5	12	8	9
	5A	F.	5	26	26	29
6	6	M.	5	6	5	5
	6A	F.	4·5	8	6	6
7	7	M.	3	18	20	20
	7A	F.	5	11	6	8
8	8	M.	2·1	9	8	9
	8A	M.	4	6	7	8
9	9	M.	2	11	6	8
	9A	M.	3	11	6	6
	9B	M.	4	7	6	11
	9C	M.	5	7	8	10
10	10	M.	2	21	17	19
	10A	F.	4	16	15	15
	10B	M.	8	13	12	14

In each series of cases the method of inoculation consisted of dividing a specimen of infected blood into the necessary quantities, and injecting these amounts into the cases to be treated, care being taken that an equal suspension of erythrocytes was present in each sample. In the table, comparisons of the quantity of blood injected, and therefore of the relative number of parasites, and the duration of the incubation period, can be carried out in each series of cases, that is between the patients bracketed together. Comparisons between the different series are not justifiable. Thin blood-films were used, and were searched for a standard time of thirty minutes each.

Series Nos. 1 to 4 show that when equal numbers of parasites are injected, the length of the incubation period tends to be the same, when it is judged by the first appearance of parasites. The similarity is less marked as regards the first fever. In series Nos. 8 to 10 different numbers of parasites were injected into the patients of each series. The incubation period was longer in the cases in which the patients received the smaller number of parasites,—again when the duration was based on the first finding of parasites. If the duration of the period is based on the first rise of temperature, little relation between the dose and the length of the incubation period can be established.

Although both cases in series No. 5 received the same number of parasites, yet the incubation-period was very much longer in patient 5A than in patient 5. The former patient had been previously inoculated with malaria but had not "taken." Possibly, therefore, there was a definite degree of resistance to malaria in this patient. If, on account of this resistance, many, but not all, of the parasites were destroyed following the second inoculation, an effect would be produced similar to that present when a smaller number of parasites is injected. As intravenous inoculation usually gives a much shorter incubation period than subcutaneous, and subcutaneous than intradermal, it would appear that parasites are destroyed in the subcutaneous tissues.

The above table shows that double the dosage does not halve the incubation period but only diminishes its duration. This may be partly accounted for by the calculations of Ross [6], who shows that doubling the dose of parasites would not, mathematically, halve the incubation period, assuming that all parasites formed reached maturity. For instance, he shows that 2,000 sporozoites should give an incubation period of ten days, whereas 15,000 are required to shorten the period to eight days.

It has been suggested that the length of the incubation period is related to the atmospheric conditions. In an investigation of sixty cases of general paralysis inoculated with malaria, I could find no relationship between the duration of the incubation period and the daily minimum atmospheric temperature up to a period of four days before the first fever, nor a relationship with the average minimum temperature at certain seasons of the year.

During the incubation period, I have observed, in some cases, an increase of pulse-rate before the first febrile paroxysm (figs. 1, 2, p. 33.) In a random sample of twenty-five inoculations, this prefebrile increase of pulse-rate occurred in 36 per cent.

With regard to the blood-changes during the incubation period, a remarkable increase of the red cells occurs. In the cases investigated by Dr. J. C. Ramsay and myself an increase of 1,700,000 erythrocytes per cubic millimetre was the greatest recorded, but Pijper and Russell [2] found an increase of 2,000,000 per cubic millimetre. This increase precedes the anæmia and does not, necessarily, occur during the incubation period. It may occur during the fever, the succeeding anæmia developing towards the end of the febrile paroxysms.

Pijper and Russell [2] report that a leucopenia appears during the incubation period. Schilling and his co-workers [7] record that, during the incubation period, the percentage of neutrophil cells with one nucleus increases from about 3 per cent. or 5 per cent. to about 25 per cent. at the first rise of temperature.

The Temperature Chart.

The temperature chart of artificially inoculated benign tertian malaria is very variable, and is perhaps complicated by the rises of temperature that occur in some untreated general paralytics.

The onset of the pyrexia may be sudden or gradual and may be preceded by initial fever (figs. 3, 4, p. 34). Korteweg believes that a sudden onset is indicative either of a relapse of malaria or of a previous attack. The figures from Claybury Mental Hospital show that a sudden onset occurs in some cases in primary attacks of malaria. Of seventy inoculations, nineteen commenced the fever with a sudden paroxysm and yet in only two of these cases had the patients had malaria previously. On the other hand, of thirty re-inoculations or relapses all commenced the fever with a sudden onset.

The character of the fever may be tertian or quotidian throughout, the latter being the more common. Gerstmann states that the former is prone to occur after intradermal inoculation. Other charts commence as tertian but become quotidian, and still others show the reverse process. Rarely, charts may be tertian in character at the beginning and end of the paroxysms, but quotidian in the middle, or tertian in the middle and quotidian at the commencement and end (figs. 6-11, pp. 35-37).

Anticipation and retardation may occur, even up to twenty-four hours. Occasionally, two paroxysms occur on one day, and it is common to see attacks of pyrexia with two peaks of high temperature. Plateau-like elevations, resembling malignant tertian fever, sometimes occur. The degree of pyrexia is usually from 103° F. to 105° F. The highest I have seen was 107·2° F.

Spontaneous cessation of the paroxysms may take place. It is not necessarily due to previous malaria, although the condition often occurs in a second series of paroxysms. It is apparently dependent on the patient, for I have inoculated four patients at one time from the same source, and found that although the fever terminated spontaneously in one case, quinine had to be given to stop the paroxysms in the other cases. Again, blood taken from two patients whose paroxysms did not cease spontaneously was injected into two other paralytics. In each case spontaneous cessation of the fever occurred. Blood from these two cases, injected into two other patients, gave rise to fever which had to be terminated by quinine.

Different strains of *Plasmodium vivax* may give rise to different types of pyrexia. Bunker and Kirby [8] found that one strain reached 106° F. in only 3 per cent. of elevations, whereas another did so in 64 per cent. Comparing one strain in use at Claybury with a strain in use at Bexley Mental Hospital, I found that completely tertian charts were more common in the former than in the latter strain.

Finally, it may be recalled that other conditions, such as tuberculosis and erysipelas, may produce fever resembling that of malaria (figs. 16, 18, pp. 38, 39).

Clinical Condition during the Pyrexia.

General paralytics vary considerably in their reaction to malaria. Some do not feel at all unwell, as, for instance, one man who read the paper when his temperature was 105° F., and many do not undergo all of the usual stages. In an analysis of 100 rigors occurring in twenty-four patients at Claybury Mental Hospital, it was found that the duration of the shivering was less than eighty minutes in 85 per cent. of rigors. The length of the rigor was found to be independent of the patient. Very rarely the stage of sweating may occur many hours after the temperature has dropped to normal (fig. 19, p 39).

Very high pulse-rates may occur. I have seen 180 beats per minute in two patients who were apparently none the worse for the rapid heart's action. The respiration rate may reach 60 a minute. These high rates occur only during the pyrexia.

Herpes labialis is fairly common. Marked enlargements of the spleen or liver are

rare in primary attacks, but, as Gerstmann [1] points out, are more common in subsequent series of paroxysms. No permanent increase in weight of the spleen occurs, as is shown by a series of fourteen deaths occurring after malarial therapy. Spleens from these cases weighing less than 160 grm. were found in 71·4 per cent. The normal weight of the spleen is given as being from 150 to 200 grm.

Epistaxis occasionally takes place and may appear irrespective of the time of occurrence of the fever.

The Blood.

The increase in the number of the erythrocytes has already been mentioned, but the succeeding anæmia has not yet been described. This may be very profound, reaching 1,700,000 cells per c.mm. in one patient at Claybury. In spite of the extreme anæmia 5,000,000 red cells were reached within three weeks. Although the degree of anæmia varied considerably, in one case being 1,700,000 cells per c.mm., and in another 3,300,000 per c.mm., yet in each case 5,000,000 red cells per c.mm. were present three weeks later. The patients who received quinine alone regenerated erythrocytes as rapidly as did those who received neokharsivan in addition. No tonics were given.

Russell [2] found that the sedimentation rate of the red cells may be slightly increased during the incubation period and markedly so during the fever. Pijper and Russell [2] found that the percentage volume of the red cells increased during the incubation period.

Although a leucocytosis is reported as being present in the untreated general paralytic, a leucopenia is more common during malarial therapy. Pijper and Russell [2] found that, with daily counts, the leucocytes varied from 5,000 to 10,000 per c.mm., and that there was a certain degree of inverse relationship between the numbers of leucocytes and of parasites. Rubitschung [9] points out that the leucocyte curve corresponds approximately to an inverted fever curve.

Schilling and his co-workers [7] found that the percentage of neutrophil cells with one nucleus increases, remaining well above normal even in the apyrexial periods. The large mononuclears and the lymphocytes are increased. As the fever begins these cells commence to decrease in number whilst the neutrophil cells increase.

The Parasites.

The changes that may occur with regard to the gametocytes have already been described. No other change has been observed in the two strains in use at the Wagner-Jauregg clinic. One strain has been through eighty-five, and the other 100, passages.

Korteweg [10] states that "initial" fever commences when the parasites number from 1 to 2 per c.mm. There would appear to be a relationship between the number of parasites present and the degree of pyrexia in any one patient. Nevertheless, the same number of parasites does not give rise to the same degree of pyrexia in different patients.

Termination of the Pyrexia.

Blood-inoculated benign tertian malaria reacts very readily to quinine. Gerstmann [1] reports that a course of quinine bisulphate consisting of 0·5 grm. twice a day for three days followed by the same quantity once a day for four days, is sufficient to prevent the occurrence of relapses. On the other hand, at Claybury the patients receive by mouth a total of 12 grm. of quinine bisulphate spread over a period of seventeen days, and yet, in a series of sixty blood-inoculated cases, watched for at least six months after the course of malaria, one relapse occurred. No other parasiticidal drug was given to the patients in these cases. In a series of sixty-one cases, reported by Yorke and Macfie [11], the patients were treated orally for two to four days, practically all receiving 1·8 grm. a day for three days, and again only one (1·6 per cent.) relapsed with malaria.

With regard to mosquito-inoculations, Yorke [12] records that of twenty-seven cases in which the patients were given the same quinine treatment as the blood-inoculated cases, sixteen (59·2 per cent.) relapsed.

At Claybury, of three paralytics inoculated by means of mosquitoes by Colonel S. P. James, two (66 per cent.) relapsed, having received the same course of quinine as did the sixty blood-inoculated cases.

Parasite, without clinical, relapses are not included in any of the above figures taken from the Claybury records.

As regards the period at which these relapses occur, they resemble those of the naturally-acquired infection as reported by Caccini [13]. This worker found that, in sixty-two cases treated with quinine, relapses occurred from seven to thirteen months after the primary malaria. In Yorke's [12] series of twenty-seven mosquito-inoculated cases, this long interval of time before the relapses occur was also found, one case relapsing eight months after the original attack. At Claybury the relapses occurred from six to seven months after it.

In untreated, naturally-acquired benign tertian malaria, Caccini [13] observed that relapses occurred either from five to eighteen days or from three to four months after the initial malaria. It is interesting to compare these relapses with those that have taken place in seven cases of blood-inoculated malaria at Claybury, in which the patients were given only a total of 1·2 grm. of quinine bisulphate in two doses. Every case had relapsed within three weeks.

The Value of Malarial Therapy.

Gerstmann [1] reports on the results of the treatment of 400 cases of general paralysis. His observations were made, in each case, at least two years after the treatment had been given. Of these cases 33 per cent. were undergoing good remissions, and in 14·25 per cent. the paralytic process was arrested or an incomplete remission had set in. Most workers in this field report a somewhat similar number of successes in mixed series of cases. If, however, the cases are selected, and only those with short histories of general paralysis are treated, better results are obtained, as is shown in the following table of sixty-three unselected cases treated at Claybury Mental Hospital.

Duration of disease before treatment (in months) ...	2—6	7—12	13—18	19—24	25—30	Over 30
Number treated	23	8	7	7	3	15
Number discharged ...	14	5	4	1	0	1
	(60·9 %)	(62·5 %)	(57·1 %)	(14·3 %)		(6·6 %)
	23 (60·5 %)			2 (8·0 %)		
	25 (39·7 %)					

At present it is too early to make any definite statements with regard to the duration of the remissions of general paralysis, although, in Austria, two complete remissions have now persisted for six and a half and seven and a half years. A considerable number have now persisted for from four to five years.

As spontaneous remissions occur occasionally in general paralysis without any treatment being given, it is necessary to compare the above results with improvements occurring in untreated cases. Tophoff [14], in 289 paralytics, observed complete spontaneous remissions in 4·8 per cent., but some of these followed intercurrent fever. With regard to the duration of the remissions, the same worker found that of fifty-seven cases of remissions 73 per cent. had relapsed within a year.

On the whole, it may be said that remissions occur from four to seven times as frequently in the treated as in the untreated cases.

In conclusion, my thanks are due to Dr. G. F. Barham, Medical Superintendent of Claybury Mental Hospital, for permission to publish details of cases treated there.

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CHARTS.

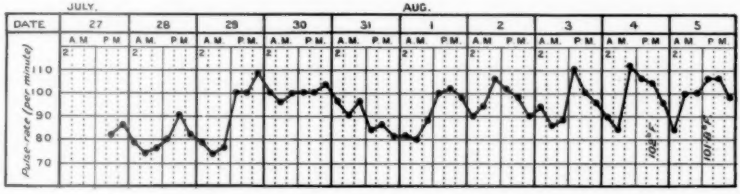

FIG. 1.—Pulse-rate. Inoculation performed subcutaneously on July 27. Temperature subnormal except where otherwise stated. Note increase of pulse-rate two days after inoculation and seven and a half days before onset of fever.

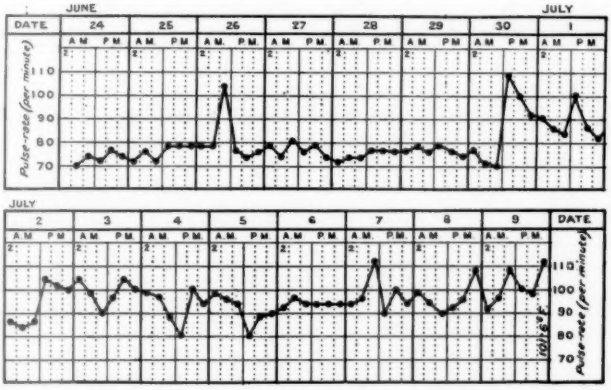

FIG. 2.—Pulse-rate. Inoculation performed subcutaneously, June 24. Temperature subnormal except where otherwise stated. Note increase of pulse-rate six and a half days after inoculation and nine days before onset of fever.

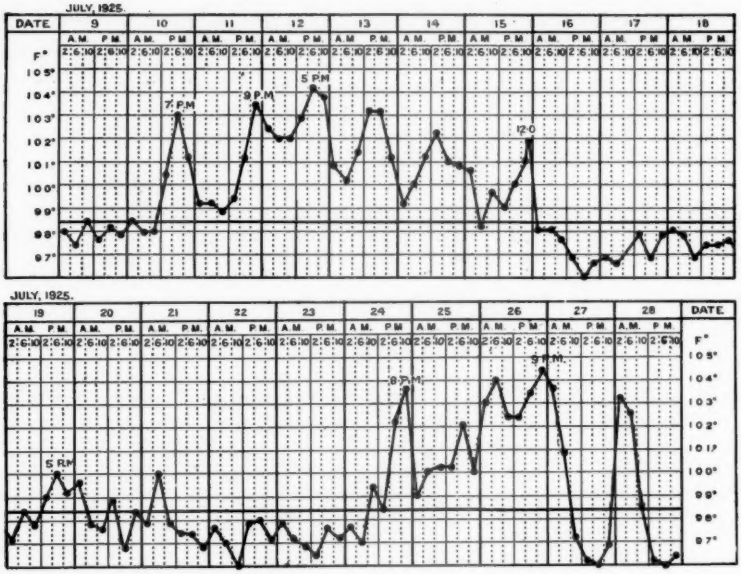

FIG. 3.—Initial fever. Prolonged rise of temperature from July 10 to 16, irregular from July 19 to 21, further prolonged rise from July 24 to 27.

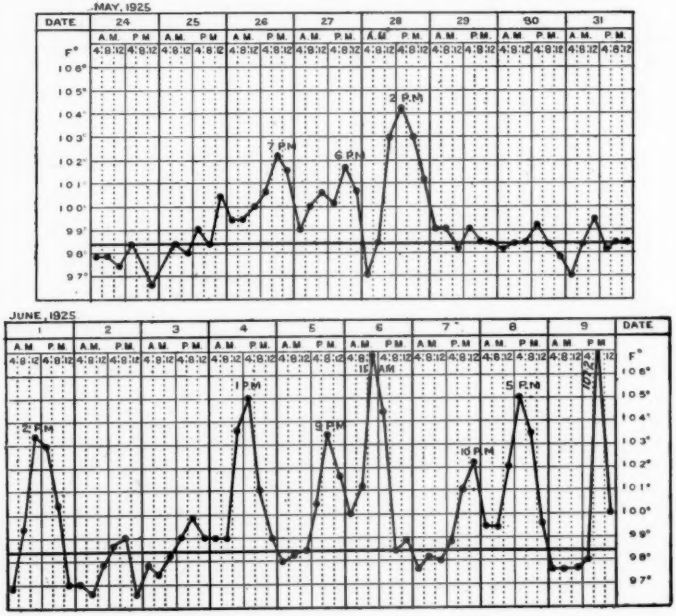

FIG. 4.—Initial fever. Irregular from May 25 to 28, a single febrile paroxysm on June 1, irregular again from June 3 to 8.

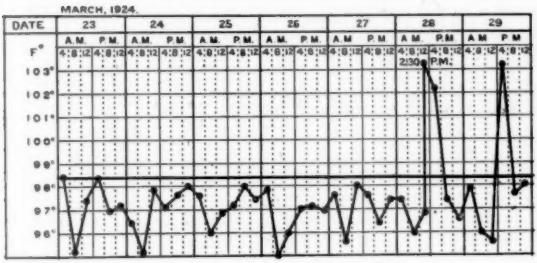

FIG. 5.—Sudden onset of paroxysms.

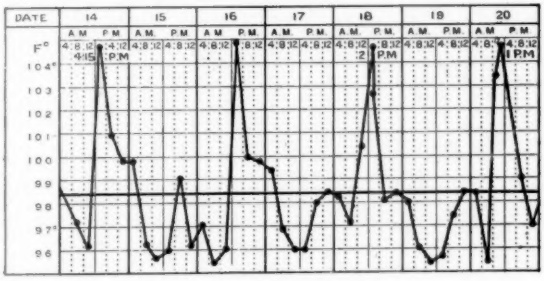

FIG. 6.—Regular tertian fever.

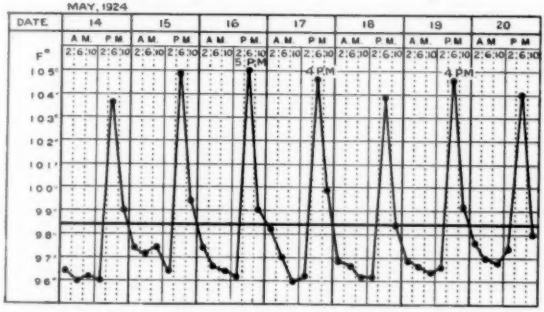

FIG. 7.—Regular quotidian fever.

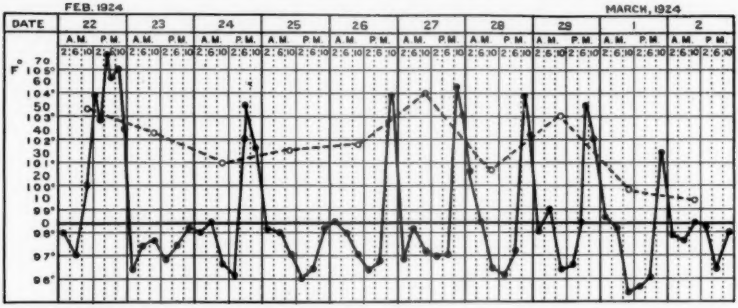

FIG. 8.—Tertian fever becoming quotidian. Progressive decrease of the pyrexia. Number of parasites in 100 microscopic fields (thin films, 1/12 in. oil-immersion). Scale of parasites to left of chart between figures for temperature.

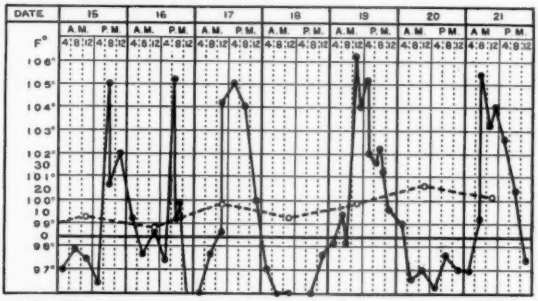

FIG. 9.—Quotidian fever becoming tertian. Number of parasites in 100 microscopic fields (thin-films, 1/12 in. oil immersion) are shown, scale on left of chart.

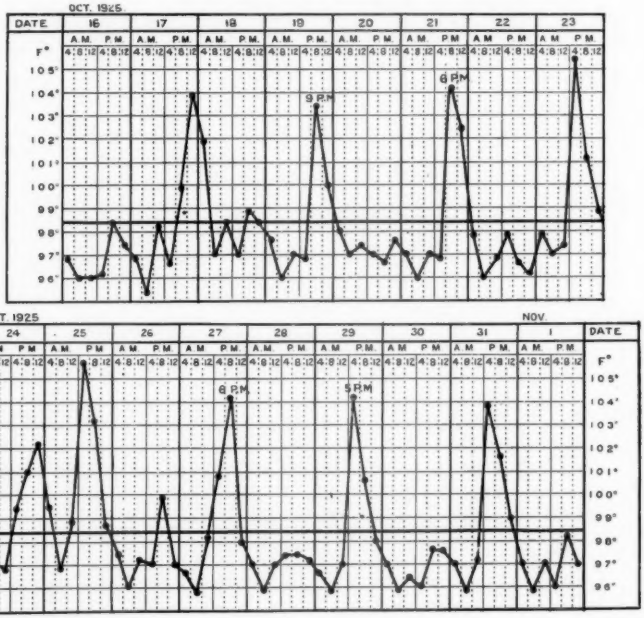

FIG. 10.—Tertian fever becoming quotidian and returning to the tertian type.

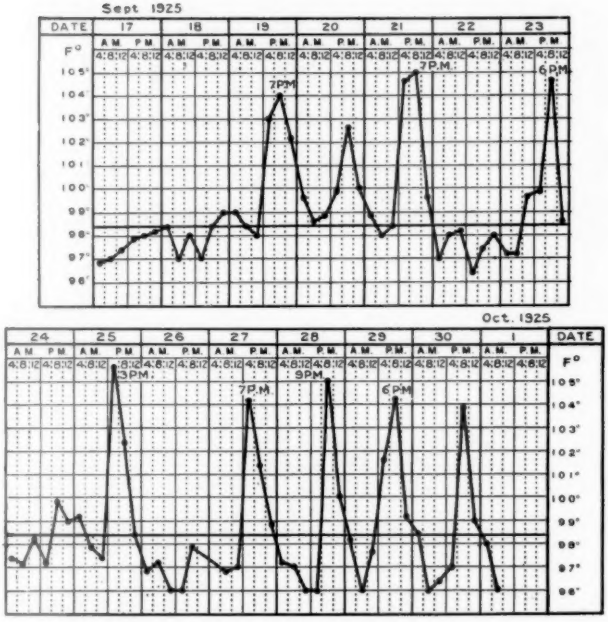

FIG. 11.—Quotidian fever becoming tertian and returning to the quotidian type.

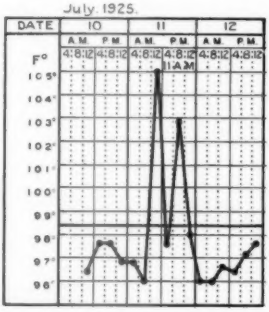

FIG. 12.—Two febrile paroxysms occurring within twelve hours.

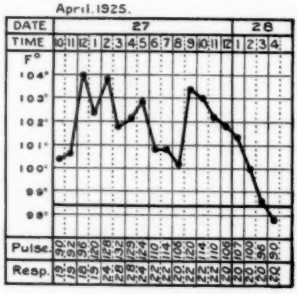

FIG. 13.—Several peaks of high temperature occurring during one febrile paroxysm.

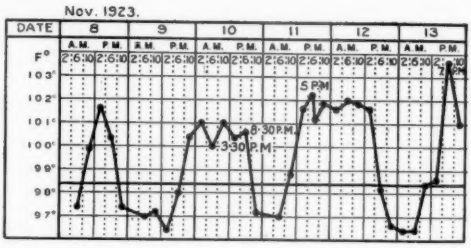

FIG. 14.—Prolonged, plateau-like paroxysms with short, fever-free intervals resembling malignant tertian malaria, from a case of artificially-inoculated benign tertian malaria.

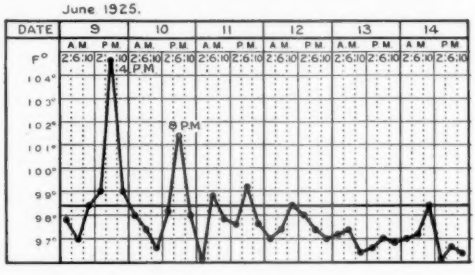

FIG. 15.—Progressive decrease of the pyrexia followed by spontaneous cessation. Compare with fig. 18

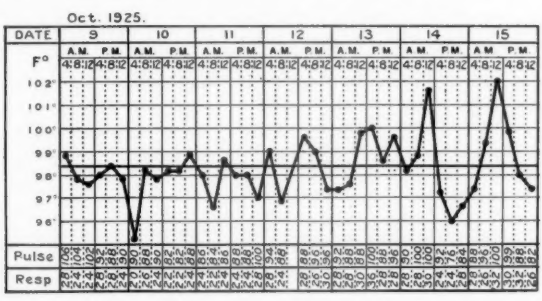

FIG. 16.—Pulmonary tuberculosis resembling the gradual type of onset of artificially inoculated malaria.

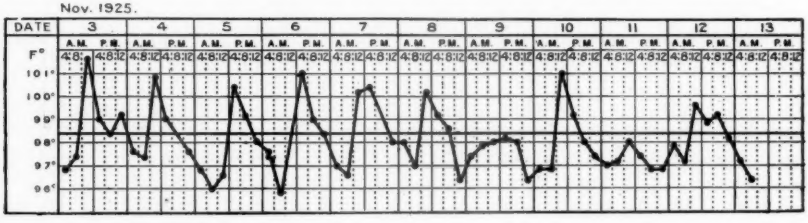

FIG. 17.—Pulmonary tuberculosis chart commencing as quotidian and becoming tertian. Resembles artificially-inoculated malaria as regards the type of chart but degree of pyrexia is not so great.

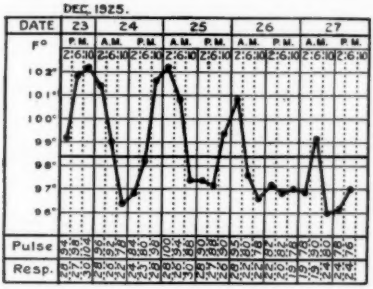

FIG. 18.—Erysipelas resembling therapeutic malaria. Compare with fig. 15.

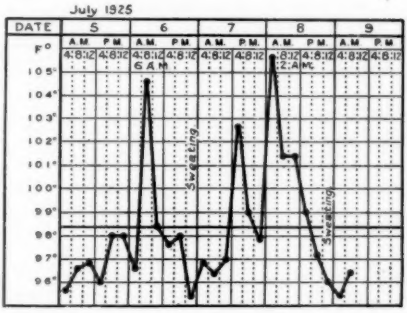

FIG. 19.—Sweating occurring many hours after the temperature had returned to normal.

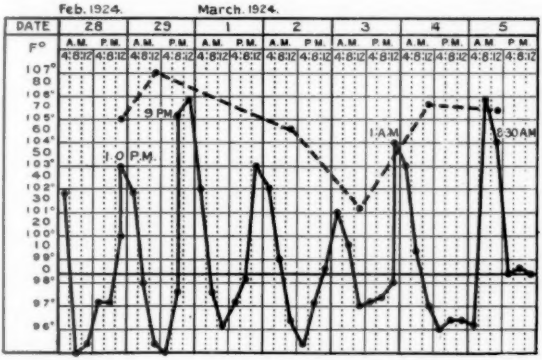

FIG. 20.—Number of parasites in 100 microscopic fields (thin-films, 1/12 in. oil immersion) varying with temperature. Scale of parasites to left of chart between figures for temperatures.

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Host-Parasite Relationships among Human Protozoa.

By ROBERT W. HEGNER, Ph.D.

(Professor of Protozoology in the Johns Hopkins School of Hygiene and Public Health, Baltimore, Maryland, U.S.A.)

PARASITOLOGY is a subject of importance both to zoologists and to medical men; the former are primarily interested in the parasite—its morphology, physiology, life-cycle and classification; the latter, in the reactions of the host—its symptoms, pathology and treatment. Furthermore, the public health aspects of parasitology have become more and more prominent during the past half-century. It seems desirable to bring these various view-points together into one programme, and this I have attempted to do; the result is indicated in the outline that has been prepared for you.

(I) THE EPIDEMIOLOGY OF TRANSMISSION.

The protozoa that live in man may conveniently be divided into three groups: (1) the "intestinal" protozoa, (2) the blood-inhabiting protozoa, and (3) the tissue-inhabiting protozoa. The intestinal protozoa comprise eleven species that are transmitted by the contamination of food or drink by cysts (five species of amœbæ—*Endamœba histolytica*, *Endamœba coli*, *Endolimax nana*, *Iodamœba williamsi*, and *Dientamœba fragilis* (?); four species of flagellates—*Chilomastix mesnili*, *Embadomonas intestinalis*, *Tricercomonas intestinalis*, and *Giardia lamblia*; one species of coccidia—*Isospora hominis*; and one infusorion—*Balantidium coli*); one species, transmitted by the contamination of food or drink by trophozoites (*Trichomonas hominis*); and three species transmitted by contact in the trophozoite stage (*Endamœba gingivalis*, *Trichomonas buccalis*, and *Trichomonas vaginalis*). The blood-inhabiting protozoa consist of two species transmitted by tsetse-flies (*Trypanosoma gambiense* and *Trypanosoma rhodesiense*); one species transmitted by triatoma bugs (*Trypanosoma cruzi*); three species probably transmitted by phlebotomus sandflies (*Leishmania donovani*, *Leishmania tropica*, and *Leishmania americana*); and three species transmitted by anopheline mosquitoes (*Plasmodium vivax*, *Plasmodium malariæ*, and *Plasmodium falciparum*). The method of transmission of the single tissue parasite (*Sarcocystis* sp.?) is not known.

Transmission from one host to another is a vital matter for the parasite and of great importance to those interested in public health work, since control measures are often most easily applied during this period in the life-cycle. Most of the intestinal protozoa are in the infective stage when they leave the host, and their problem is to reach a new susceptible host before adverse conditions outside of the body bring about their destruction. Blood-inhabiting protozoa all depend for their transmission on insect vectors in which certain stages in their life-cycles must occur before they again become infective to human hosts.

A survey of the methods of transmission reveals the fact that the protozoa are passive throughout and that it is the host that brings about its own infection. Thus the cysts of *Endamœba histolytica* have no powers of locomotion but are ingested by the host in food or drink, for the contamination of which man is himself responsible; and the malarial organisms are forcibly drawn into the digestive tract of the mosquito, and later the infective sporozoites are injected by the same insect host into the blood of another human host.

Recently I have carried on some experiments that indicate that the trophozoites of intestinal protozoa, as well as their cysts, are capable of passing through the mouth, œsophagus and stomach, and setting up an infection in the intestine. This

is, of course, the only possible method of infection available for *Trichomonas hominis*, which does not produce a cyst stage in its life-cycle. I have demonstrated that *Trichomonas muris* of the rat can pass unharmed through the alimentary canal anterior to the cæcum and set up an infection in that organ. Further experiments, still unpublished, also prove that *Balantidium coli* from the pig, *Endamœba histolytica* from cultures, *Endamœba muris* from rats, *Trichomonas* and *Chilomastix* from guinea-pigs, and *Giardia canis* from dogs, when fed to guinea-pigs, reach the posterior end of the small intestine in a living condition, apparently capable of colonization in that animal if conditions there are favourable. The length of life of trophozoites outside the body is, however, comparatively short; hence, although trophozoites may under exceptional conditions bring about infection, the cysts are much more important.

(II) Host-Parasite Relations during a Natural Infection.

(1) *The Course of a Primary Infection.*

The course of infections with the protozoa of man are well known, but confusion exists regarding the various periods recognized by parasitologists and clinicians. The clinical periods are descriptive of the reactions of the host: (1) the incubation period, from the entrance of parasites to the appearance of symptoms; (2) the period of symptoms; (3) the crisis, and (4) convalescence. The zoological periods are concerned with the growth and multiplication of the parasites; for these periods I suggest the following terminology: (1) the prepatent period, from the entrance of parasites to their subsequent recovery from the blood or fæces; (2) the patent period, during which parasites are recoverable, and (3) the sub-patent or post-patent period, when parasites can no longer be recovered, either because the host has become free from them, or because they are not present in the blood or fæces or are too few in number to be found by the laboratory methods employed. The terms, "rise," "peak," and "fall" refer, of course, to the increase in parasites to the highest number and their subsequent decrease.

Usually the host does not become entirely free from parasites when symptoms subside, but continues to harbour parasites in his body, thus becoming a carrier. Such a host may suffer a relapse when conditions again become favourable for the multiplication of the parasites.

(2) *The Distribution and Localization of the Parasites within the Host.*

Parasitic protozoa are not only transmitted from man to man in a passive manner, but are distributed to various organs within the host by the host itself. Thus, intestinal protozoa are swallowed by the host, pass through the stomach, and are carried down the small intestine by peristalsis; and blood-inhabiting protozoa are distributed by the blood-stream. For example, the cysts of *Endamœba histolytica* are carried through the small intestine and into the large intestine, apparently undergoing excystation where stasis occurs. In this way the primary site of infection is reached. If the intestinal contents chance to be in a fluid condition, the cysts are probably carried out of the body without excysting. If extensive ulcers are produced in the intestinal wall, amœbæ get into the blood-stream, in which they seem able to live, and are transported to various parts of the body, where they may bring about the formation of abscesses in the liver, brain and other secondary sites of infection.

(3) *Passive (Natural) Resistance of the Host.*

Man, or any other host species, cannot be parasitized by most species of protozoan parasites. Any host characteristic that is responsible for this condition may be referred to as a kind of passive resistance. Just what obstacles a particular parasite has difficulty in overcoming in successfully invading a host are not well known. Intestinal parasites must be able to withstand various digestive juices and the complex chemical medium within the intestine; conditions must be suitable for excystation; and the diet of the host and intestinal flora must be such as to enable

the parasite to grow and multiply. Protozoa encounter a less varied medium when they enter the blood-stream, but the blood of different species of animals is sufficiently diverse to prevent infection except by a very few species of protozoa.

(4) *Passive (Natural) Resistance of the Parasite.*

The resistance of the host is overcome by the parasite in various ways. When transmission occurs by contact, as in the case of the trophozoites of *Endamœba gingivalis* and *Trichomonas buccalis* of the mouth and *Trichomonas vaginalis* of the vagina, the change in environment is very slight and no resistant stage of the parasite is necessary in order that the primary site of infection may be reached. The intestinal amœbæ and flagellates may be able to resist the conditions in the mouth, œsophagus, stomach and small intestine even when in the trophozoite stage, as pointed out above, but usually, no doubt, infection is brought about by cysts which are provided with resistant walls. The infective stages of blood-inhabiting protozoa need no resistant walls, since they pass directly into the blood-stream. Here they must be able to withstand the blood-serum and escape phagocytosis.

(5) *The Parasites' Method of Attack.*

Having reached the primary site of infection the true invasion of the host begins. Each parasite has its own method of attack, such as the penetration of certain tissues or organs and the secretion of zootoxins. The details of the attack upon the host are little known.

(6) *Changes in the Host caused by the Parasite.*

Parasites that injure their hosts are pathogenic. If the injuries are so severe as to interfere radically with the normal functions of the organs of the host, symptoms appear. The host may build up an active resistance against such an attack, which we call immunity. The pathology of most protozoan diseases is well known, but very little is known about the genesis of the conditions observed. Likewise, the symptomatology of the protozoan diseases of man has been thoroughly described, but the way in which the functions of the organs are disturbed is still obscure. There is no doubt that the human host builds up an immunity against certain protozoa. For example, one attack of oriental sore, due to *Leishmania tropica*, confers immunity to further infection; and immunity may apparently be acquired to malaria. This subject, however, is one that has been very little studied.

(7) *Changes in the Parasite due to Residence in the Host.*

Since protozoa are living organisms, they also are probably capable of building up active resistance against the attacks of the host. It is obviously difficult to demonstrate such a parasite immunity, although "fastness" may be due to such a phenomenon. Whether changes in virulence may occur in a strain of protozoa while residing in a host is still an open question.

8.—*Host-parasite Adjustments during an Infection.*

The changes in the relations between host and parasite during an infection bring about chronicity, the carrier condition, latency and relapse. There is an equilibrium reached between host and parasite leading to the carrier; but at any time the physiological state of the host may change, and the parasite increase so rapidly in numbers as again to call forth symptoms. The problems involved here are of great importance, since the elimination of carriers would in many cases mean the eradication of the disease. For example, in many localities the malarial parasites pass the winter not in the mosquito, but in the human host. If these human carriers could be sterilized there would be no relapses the following spring and hence no reservoirs from which mosquitoes could become infected.

The main problem seems to be to determine the mechanism of relapse. In a paper now in the press (*American Journal of Hygiene*, July, 1926), Dr. MacDougall

and I have described certain experiments on bird malaria which indicate that the sugar content has a striking effect on the blood as a medium for the growth and multiplication of the malarial organisms. For example, when canaries were fed on sugar during the daily segmentation period the parasite number did not reach a peak and then fall as usual, but continued to rise until the birds died; and when canaries were treated with insulin the parasite number did not rise as high, on the average, as in control birds. The sugar content of the blood may therefore be one of the factors involved in the production of a relapse.

9.—*Therapeutics.*

The host may be aided in its resistance to protozoan parasites either by biological therapy or by chemotherapy. The questions involved are: (1) How can the host be strengthened by nutrition, &c.? (2) How can his resistance be fortified by vaccines, antitoxins, &c.? (3) What drugs can be employed to destroy the parasites, and how do they act? and (4) What drugs are of use in building up the host resistance and vitality?

10.—*The Route taken by Parasites in Escaping from the Host.*

Many and varied are the methods by which parasites escape from their hosts. Those of the protozoa are, on the whole, quite simple. The protozoa of the mouth and vagina pass to new hosts during kissing or coitus; intestinal protozoa escape with the fæces; and blood-inhabiting protozoa are sucked out by insect vectors.

(III) Host-Parasite Specificity.

This term means the association of a particular species of host with a particular species of parasite. Among human protozoa the host-parasite specificity is quite rigid. Most of these protozoa occur regularly in no other species of animal except the blood-inhabiting species in certain insect vectors. *Balantidium coli* is an exception, since it seems to be a regular inhabitant of the intestine of the pig and has been recorded from monkeys a number of times. Some of the problems involved in this subject are as follows:—

(1) To what extent does the behaviour of the host and that of the parasite determine host-parasite specificity?

(2) Do species of protozoan parasites that are restricted to one species of host gain access to other species of hosts?

(3) What factors within a host enable natural parasites to bring about an infection and prevent foreign parasites from doing so?

(4) How may we account for laboratory infections in foreign hosts?

(5) What conditions are responsible for differences in susceptibility between young and adult animals?

(6) What host-parasite interactions terminate an infection or bring about periods of latency and relapse?

The data available are not sufficient to provide definite answers to these and other questions that have a bearing on host-parasite specificity. This field offers particularly favourable material for biological investigation and its study would add results of great importance to the subject of host-parasite relationships.

(IV) Prevention and Control.

A full knowledge of host-parasite relationships is necessary for satisfactory prevention and control. Only on the basis of such knowledge are we able to work out proper methods for the protection of the individual from protozoan infections (personal hygiene) and to prevent the spread of these infections in communities (public health measures).

In conclusion, what I have presented to you in the short time available is intended merely as an outline, the object of which is to arrange in logical order the various events in a protozoan invasion of man that are of interest to zoologists, medical men and public health officers, and thus to bring these various view-points into a single programme, and to focus attention on certain phases of the subject that are especially in need of investigation.

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EDITED BY

SIR WILLIAM HALE-WHITE, K.B.E., M.D.

AND

T. WATTS EDEN, M.D.

UNDER THE DIRECTION OF

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SECTION OF PATHOLOGY.

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Section of Urology.

President—Mr. R. H. Jocelyn Swan, M.S.Lond., F.R.C.S.

Some Reflections upon Villous-covered Tumours of the Urinary Bladder.

PRESIDENT'S ADDRESS.

By R. H. Jocelyn Swan, M.S.Lond., F.R.C.S.

It is customary in this Section to make a few remarks on some subject that will invite a free discussion, and I propose this evening to give you some impressions that I have formed in dealing with tumours arising in the mucous membrane of the bladder, particularly as regards the diagnosis and treatment.

Diagnosis.

I propose to confine my remarks to those tumours which we see so commonly, the villous-covered growths arising from the epithelial elements. I do not propose to discuss the true epitheliomata nor the more uncommon adeno-carcinomata, nor shall I touch upon the rarer forms of vesical tumour, the myxoma, fibroma or sarcoma. Again, I do not wish to trouble you with the commonplace eulogy of the cystoscope as a means of diagnosis in these cases, except to say that it still appears to be necessary to lay stress upon the fact accepted at once by the urologist, but not yet digested by the profession at large, that every case of hæmaturia should be subjected to a cystoscopic examination before any attempt at treatment, operative or non-operative, is made.

We have been in the habit of classifying these tumours as papillomata and as carcinomata, and we have had at the back of our minds the impression that a papilloma may develop malignant characters if left untreated. Are we correct in this assumption or are we not in truth dealing with a specialized form of epithelial tumour which may possess some malignant characteristic from the outset? Have we yet lived down the experience of former surgeons, who removed these tumours from the bladder in a manner which we should now look upon as very incomplete, namely, by grasping the mass in forceps and twisting off the exuberant growth, leaving the base and the growth-bearing area *in situ*—from which local recurrence took place? Doubtless this accounted for many cases of recurrent growth after operation, but we now know that a large number of these villous-covered tumours must have been carcinomatous from the beginning, although looked upon as innocent. Our views as to the nature of these tumours have altered considerably in recent years and we now recognize many gradations, from the obviously innocent fimbriated papilloma to the infiltrated nodular growth still covered with villous processes. Between these two occur a number of cases of villous-covered tumours presenting considerable difficulty in diagnosis, and it is particularly with regard to this group of cases that I wish to speak to-night. Doubtless many cases, upon cystoscopic examination, can readily be stated to be innocent or malignant, but there are many

others about which doubt exists. The fine, fimbriated growth attached to the vesical wall by a thin pedicle, the tumour showing long, delicate villous processes waving to and fro in the eddies in the bladder, will give rise to no difficulty in diagnosis—nor will the raised plaque of growth with uneven, rolled margins with a central area covered by coarse, stunted villi. But can we be certain of the true pathology of all villous-covered tumours that are seen in a bladder? It must be in the experience of all of us, after the removal of one of these tumours by open operation, to have received a report from the pathologists that is at variance with our clinical conception of the case; and it comes to us almost as a shock to find, that when one has done an extensive resection for a growth that appeared to be malignant, a report is forthcoming to say that the tumour is innocent and not malignant, though we have probably done the best thing for the patient. Yet it is not uncommon to find that later on in the course of the same case there is a recurrence of growth in the bladder and that this time it is undoubtedly malignant.

There can no longer be any doubt that a benign papilloma may, if left untreated, develop malignant changes, infiltration of the deeper planes of the bladder-wall taking place. On the other hand, papillomata may recur after removal, either in the site of the previous tumour or on other areas of the bladder-wall, or in the suprapubic scar of the operation. These recurrent tumours can only arise as entirely new formations in the bladder, by recurrence from incomplete removal or by direct implantation of tumour-cells upon an otherwise normal bladder-wall, and they undergo independent growth, to form a new tumour mass.

Where, then, are we to draw the line between innocency and malignancy in these cases? Are we justified in our assumption that the so-called villous papilloma is an innocent tumour which may develop malignant changes; or should they be looked upon as precancerous conditions, or classified as malignant tumours from the outset, or be given another name which does not imply a simple, innocent, benign tumour? Certainly they do not conform with the ordinary papillomata seen elsewhere in the body, and I am inclined to classify them, in a special group of their own, as "epithelial vesical tumours." Then, again, consider the type which forms a fairly rapidly-growing villous tumour in the bladder which is undoubtedly malignant and the base of which shows definite infiltration of the vesical muscle-planes with epithelial cells. This type comprises a fair percentage of villous tumours, but the one significant clinical feature is the comparatively long time that may elapse before there is any sign of extravesical metastases, in contradistinction to the true epithelioma from which glandular spread occurs fairly early. This is to a certain extent in conformity with other malignant tumours in the body, and for years I have been in the habit of teaching that any malignant growth that shows a tendency to fungate rather than ulcerate is unaccompanied by glandular metastases for a comparatively long time and gives a much better prognosis after removal than does the ulcerating form. In our work at the Cancer Hospital this is frequently exemplified, whether the growth occurs in the lip, the tongue, the stomach, the rectum, or elsewhere.

I do not wish to wander into this domain of microscopic pathology in discussing these cases, but I wish to elicit a few facts from our present knowledge of these tumours which will help us in arriving at a diagnosis between a benign and a malignant tumour. I shall also endeavour to bring out some points that will direct our treatment of them, for I think all will accept it as a truism that treatment will depend upon exact diagnosis. First, as regards the diagnosis: little assistance is gained by the length of time that has elapsed since the first occasion on which the patient noticed hæmaturia, but I think that the frequency of the attacks of bleeding, or rather the *diminishing intervals* of freedom from hæmaturia, afford suspicion of malignancy, either commencing in an old-standing benign tumour or starting *de novo*. How often do we see cases in which there have been occasional attacks of bleeding in the urine for perhaps five or even ten years at intervals of

many months, but in which the frequent recurrence of hæmorrhage during the recent months has caused them to seek advice, a clinical history that to my mind should give rise to a strong suspicion of carcinoma. Again, the patient will tell us that until recently the attacks of bleeding have been unaccompanied by any other symptom, but that now he has increased frequency of micturition or pain in the glans penis after micturition, either of which symptoms may be due to infiltration of the vesical wall, with inability on the part of the bladder to accommodate a normal capacity, or due to spontaneous cystitis which so frequently accompanies a malignant growth.

The age of the patient affords little assistance, for I have seen many benign growths in old patients and also carcinomatous tumours in comparatively young people. Symptoms due to the mechanical interference with the flow of urine may occur with either, namely, retention of urine due to the plugging of the internal urethral orifice by the exuberant growth or by blood-clot, whilst I have seen hydronephrosis as a result of obstruction of one ureteric orifice by both a benign and a malignant tumour.

SEX AND AGE INCIDENCE OF VILLOUS-COVERED TUMOURS OF THE BLADDER.

Sex.

	Males	Females	Total
Papilloma	32 = 74 per cent.	11	43
Carcinoma	36	36	72
	68 = 59 per cent.	47	115

Age.

	Papilloma	Carcinoma
Between 31 and 40	1	1
,, 41 ,, 50	9	7
,, 51 ,, 60	12	20
,, 61 ,, 70	15	25
,, 71 ,, 80	5	16
,, 81 ,, 90	1	2
	43	71
Not stated	2	1
	45	72

Much more evidence can be obtained in these cases by a careful cystoscopic examination, but even then it is not often easy to be dogmatic, and the clinical evidence is not always parallel with the pathological. Many cases occur in the two extremes, when it can be said with fair certainty that such a tumour is benign and another is malignant, and I have found that the following points have been helpful to me:— (1) Long, slender, waving, villous processes, semi-translucent in appearance, are nearly always benign, but (2) where the processes are *stunted*, *more compact*, and appear *more dense* and *fleshy* I look upon these as malignant. (3) Where the surface of the growth is of *varying* appearance or where there are areas of necrosis, suspicion of carcinoma should arise. (4) One is apt to speak of the pedicle of these tumours as affording an indication of malignancy, but I would only say how difficult it is in these cases to see the pedicle, the growth appearing to sit on the vesical wall like a raspberry on its base. I pay more attention to the appearance of the mucous membrane immediately surrounding the base of the tumour than the pedicle itself; if this shows any thickening, if it is raised into small folds or shows small semi-translucent areas of œdema or congestion, I am then inclined to look upon the tumour as carcinoma. (5) We occasionally see small plaques in the bladder, quite sessile and only slightly raised from the surface, which are pathologically benign but always suspicious. (6) Multiplicity of growths in the bladder is no evidence of malignancy,

and I am inclined to think that multiple growths are more often innocent than malignant. (7) I look upon all nodular growths, the small, rounded, solid-looking masses seen in the bladder, as directly carcinomatous and do not include them in the present consideration.

I have sometimes obtained useful help in these cases by attempting to estimate the mobility of the tumour mass on the vesical wall. This is best done by means of the diathermic electrode passed down the cystoscope. If the electrode is passed into the tumour and the current passed for a few seconds until the surrounding area appears whitened, the point will adhere. Traction upon it, or movement, will often bring the pedicle into view and the degree of mobility on the bladder wall can be estimated.

The palpation of the vesical wall for any thickening *per rectum* or *per vaginam* may be useful, but in the majority of cases it is probable that if infiltration can be felt, the growth has reached such an extent that any attempt at radical removal is contra-indicated.

I would issue a word of warning against attempting to make a diagnosis between a benign and a malignant tumour in the bladder by any examination of pieces of growth that may be passed in the urine. In a similar way I look upon the examination of pieces removed from a growth by means of an operating cystoscope as utterly useless. In any event such examination only tells us that there is a villous-covered tumour present in the urinary organs—pieces passed in the urine may even descend from one kidney—and gives no information whatever upon the all-important question of the presence or not of infiltration about the base of the tumour.

Treatment.

I have already indicated that in my view the treatment of every villous-covered tumour in the bladder will depend upon the opinion formed of its pathological nature. It may also be influenced in some measure by the position in the bladder, the size and number of the tumours present and the physical condition of the patient. We can at once dismiss any attempt to remove a growth by means of operating cystoscopes, and I would place all such operations in the same category as the earlier open operations in which the growth was snared or twisted off without any attempt being made to remove the growth-bearing area. Similarly, I would dismiss any attempt to obtain sloughing of the growth by instillation of caustic solutions into the bladder. Possibly some necrotic portions of the surface of the mass may come away, but the growth-bearing base of the tumour remains.

We can summarize our present-day treatment under (1) *diathermy*, and (2) *radical removal* by open operation, and I should like to give my views upon each of these. I know that I may express opinions at variance with some of the Members, but perhaps it may produce a topic for discussion. Diathermy and fulguration have had a fair trial, and it may not be inopportune to formulate the experience that I have personally formed of this mode of treatment. I have used diathermy both by means of a cystoscope and through an open suprapubic incision into the bladder, my choice being largely influenced by the size of the tumour to be attacked. I feel that with a large tumour, the time required to treat it at one sitting is very fatiguing to both the patient and the surgeon, whilst the repeated applications sometimes necessary with these tumours is distasteful to the patient. For my part I would use diathermy for relatively small growths that are clinically benign, either single or multiple. The small, recurrent growths seen after previous treatment seem to be especially suitable for the application of diathermy, especially those about the base of the bladder, but growths about the internal urethral meatus and upon the superior wall of the bladder may cause difficulty owing to their position. But with more extended experience and with the use of Joly's retrograde cystoscope, this difficulty has been

mainly overcome. What I wish particularly to emphasize is that I reserve the employment of diathermy solely for cases which I look upon as pathologically benign and that I do not use it in cases in which there is any suspicion of malignancy, preferring in the latter instance to proceed at once to open operation. Again, if at a subsequent examination, after an interval of about four weeks, the area treated by diathermy appears fleshy and thickened instead of having contracted down, I would then give up further attempts at diathermy and advise open operation, for I am convinced that non-reaction to diathermy is strong positive evidence of malignant infiltration. The necessity of an anæsthetic for the treatment depends upon the patient; I would advise it for nervous persons or for those who feel pain more acutely than others, and I judge this by their behaviour at the first preliminary cystoscopic examination without an anæsthetic. I think the method has the additional advantage that subsequently there is less liability to the occurrence of implantation growths upon the vesical wall, because the pieces of tumour which are removed are already killed by the coagulation process.

I do not feel so happy in using diathermy for sessile growths as I do in the case of pedunculated growths, unless they are quite small. In the case of sessile tumours it is very difficult to be sure that infiltration has not commenced in the central part, and I look upon sessile, villous-covered growths as more frequently malignant than simple; hence I prefer to remove them by open operation. My own preference is therefore to use diathermy for small tumours that are diagnosed to be benign, but to discard it in the case of those that are thought to be malignant and of those in which certain features exist that arouse suspicion of malignancy. Recently, I have combined the use of diathermy with open operation, treating the surface of the mass either with diathermy or fulguration before resecting it, in the hope of preventing small recurrent growths by implantation upon the bladder wall during the manipulations of the operation; but, so far, sufficient time has not elapsed to enable me to say whether this method has been effectual in its object.

With regard to open operation in dealing with these tumours, one cannot help confessing that the subsequent results are by no means satisfactory. How frequently do we see recurrence taking place in the bladder, either in the site of the previous growth or in other areas of the bladder wall, even in cases that, microscopically, have been pronounced to be simple. Is it that implantation has occurred during the operation, or does some unascertained cause still persist, that brings further tumours into being? Where the growth is comparatively small and not obviously carcinomatous, I make use of the older operation and attack it through a free median suprapubic incision, but I take especial care that nothing is allowed to touch the tumour during the operation. I separate the peritoneum widely, and protect the edges of the abdominal incision with tetra cloths. Then opening the bladder freely I protect the vesical incision with rubber dams and insert Thomson-Walker's retractor; the patient is then raised into the Trendelenburg position and the central blade of the retractor adjusted, a firm roll of gauze being placed between it and the bladder wall—a manœuvre which brings the vesical base into much better view and makes the subsequent removal easier. Morson's lamp is then fixed to the central blade of the retractor; it gives a much better illumination than a head-lamp. If the tumour is then gently turned over by some instrument, the pedicle can be seen and the degree of mobility on the bladder wall estimated. In all cases in which the growth occurs on the basal areas, I next pass, if possible, a small catheter into the ureter of the affected side, using this as a guide in the deeper removal of the growth-bearing area. Next, I map out the amount of bladder wall to be removed, by means of several Kocher's forceps, these latter being left on the vesical aspect of the incision used in the resection. I have no hesitation in resecting the last inch and a half of the ureter with the growth if it seems necessary, implanting it into the upper part of the deep incision by means of three fine catgut sutures, leaving a small space

immediately below it, in the suturing of the incision through which a small drainage tube is passed into the postvesical tissues and brought out through the suprapubic incision. I never entirely suture the suprapubic incision, prefering to drain by means of a large de Pezzer tube after suturing the greater part of the wound into the bladder.

These points are mainly applicable to those cases which I look upon, from all clinical considerations, as innocent, but they are modified if I look upon the growth as malignant or as one in which suspicion of infiltration of the vesical wall exists. I must repeat that I do not look upon these cases as suitable for diathermic methods, but consider that they should be subjected to free and extensive removal. I would much sooner take the risk of doing an extensive removal of such a growth, and hear afterwards that the pathological examination has failed to show any infiltration in the deeper tissues of the bladder wall, than to perform a comparatively limited operation and then find that malignant infiltration has already commenced. The steps of the operation will depend to some extent upon the position of the growth as ascertained by the cystoscope. Should it be on the anterior or antero-lateral wall of the bladder, I first open the peritoneum in order to see whether there is any extravesical spread to the peritoneal covering, any adhesion to other viscera or enlargement of the lymphatic glands along the iliac vessels which would invalidate radical removal. In some cases puckering or thickening has been found on the peritoneal surface without any formation of nodules, when the area can be isolated and the peritoneal cavity again be closed before the bladder is opened. If the growth is situated on the base of the bladder, which is by far the more usual position, I make a free suprapubic incision down to the bladder, reflecting the unopened peritoneum widely. Next, I separate the lateral aspect of the bladder, leaving as much as possible of the fatty tissue adherent to it, until I expose the extravesical portion of the ureter, freeing the latter for about two inches, provided that I have not encountered any infiltration of the fatty tissue outside the bladder. At this stage some vesical vessels are reached and ligatured. Next, the bladder is opened on the side of the growth and the position of the latter clearly defined. From this incision into the bladder, further incisions are made, completely through the vesical wall encircling the tumour, resecting the ureter and re-implanting it into the incision by suture or into a separate incision if necessary. I sew up the vesical wall around a drainage tube, which is passed through the suprapubic wound, and also drain the lateral extravesical area by means of a cigarette drain passed by a stab incision above Poupart's ligament. Carried out in this manner large areas of the vesical wall can be removed, and it has always surprised me to see how rapidly the remaining part of the bladder accommodates itself to the altered conditions.

I look upon any case that would involve the orifices of both ureters as inoperable from any radical point of view. For such to have occurred implies that almost certainly both ureters are dilated and that both kidneys have begun to feel the stress of back-pressure. To transplant such damaged ureters into the bowel or to bring them out on to the loin only invites ascending sepsis. Thus, I do not consider total cystectomy an operation that should be attempted for malignant disease of the bladder, though I think it might be done quite occasionally in those cases of very rapidly recurring papillomata which are occasionally seen, in which any other form of treatment seems to be followed by a quick recurrence of further buds of growth.

In cases of villous carcinoma of the bladder that are considered too far advanced for radical resection, either by clinical examination or during the progress of an operation commenced to remove them, much relief from suffering can be obtained by removing the fungating mass and treating the remaining base of the growth freely with fulguration. Hæmorrhage is checked, the sepsis in the bladder is diminished and the patient often thus obtains many months of comparative comfort.

In some cases, though more often in the infiltrating epitheliomatous type, the formation of a permanent suprapubic fistula by means of a de Pezzer tube is a palliative measure that helps the patient; but I must confess that I have seen little good done either by deep X-ray therapy or by radium administration. In some cases of recurrent villous growths I have used radium without any benefit and in other cases in which I have done a wide resection for villous carcinoma, I have buried a series of radium needles containing 9 mgm. of radium bromide along the line of incision into the bladder. I mention this to warn you against following my attempt to kill off any carcinomatous cells remaining, for these patients have had considerable pain after this treatment, and more than once I have had to re-open the bladder owing to the severe pain from a very indolent ulcer in the bladder which I look upon as analogous to the very slow-healing ulcer of the skin seen occasionally after prolonged exposures to radium. The vesical mucous membrane seems very susceptible to intense reaction from radium.

If I were inclined to draw any conclusions from my experience in the treatment of these cases, I would say reserve diathermic treatment for cases of small tumours that are apparently benign, even if multiple, or for small recurrent tumours after previous diathermic or operative treatment. For those cases which are definitely carcinomatous, or in which our clinical judgment inclines us to think that carcinoma is probably present, I would advise free removal by open operation—provided that the physical condition of the patient does not contra-indicate it. I feel sure that judging by the results which I have obtained in my more recent cases, partial cystectomy in the manner that I have briefly described gives much greater prospect of freedom from recurrence than resection when carried out by intravesical methods. There is one more point I should like to emphasize, namely, that in all these cases frequent cystoscopic examination should be made at regular intervals after any line of treatment, so that early recurrences can be treated without waiting for symptoms to arise.

Results of Operations on Villous Tumours of the Bladder.

Papillomata.

In 43 cases of which I have records, in two, operation was not advised owing to the advanced age of the patient and the comparatively slight inconvenience caused by the tumour. One patient died of pneumonia four days after the operation and three others cannot be traced. Of the remaining 37 cases, 21 are known to be well, and free from recurrence after the following time from the operation :—

15, 12, 8, 7, and 6 years	...	...	1 case respectively
5 ,,	...	...	2 cases
4 ,,	...	...	3 ,,
3 ,,	...	...	5 ,,
2 ,,	...	...	4 ,,
1½ ,,	...	...	2 ,,

Sixteen cases of papillomata out of these 37 recurred, 1 after four years, 2 after three years, 1 after two years, and no less than 12 at varying periods from twelve to twenty months. Many of these patients have been subjected to further open operations or to diathermic treatment, and some very interesting points arise in the further consideration of the cases. In 5 cases in which the original tumour was removed and reported upon by well-known pathologists as typically benign, the recurrent tumour was carcinomatous; in one of these cases, at the first recurrence the tumour was reported upon as innocent, but at a second recurrence, a year later, the tumour was definitely carcinomatous. In four of these cases the patients are known to have died from metastases of carcinoma and in the fifth case the patient

must be presumed to have died, as when last seen there was a massive growth in the pelvis.

In four cases the operation was followed by recurrence of growth in the suprapubic scar, and as these cases contain points of especial interest, I wish briefly to refer to them.

Case I.—A man, aged 49, who was operated upon in November, 1907, for a large growth which was reported upon by the pathologist as innocent. He had a small recurrence at the apex of the bladder which was removed by intraperitoneal partial cystectomy in May, 1908, the growth being again pronounced to be innocent. In March, 1909, another small growth was resected, when Dr. Nicholson gave his opinion that the growth was carcinomatous, but Dr. Kettle and Dr. Paine disagreed and said that it was innocent. In November, 1909, there was recurrence in the suprapubic scar; the growth was removed and found to be carcinomatous. There was again recurrence of the growth; this caused his death in February, 1911, at which time post-mortem examination failed to show recurrence in the bladder.

Case II.—A man aged 60. A benign papilloma was removed in March, 1909. Recurrence took place in November, 1912, and the growth was again removed, the pathologists again reporting it to be innocent. In July, 1918, he had a large mass of carcinoma in the bladder involving the pelvic tissues, and nodules of carcinoma in the suprapubic scar.

Case III.—A man aged 49. A villous tumour was removed from his bladder in July, 1908, and reported to be a typical villous papilloma. In May, 1909, there was a hard nodule in the suprapubic scar, which on removal was found to be carcinomatous, but there was no recurrent growth in the bladder.

Case IV.—A man aged 57. In November, 1919, a growth was removed from his bladder and reported to be innocent. Recurrent growths were treated by diathermy in 1920; in 1921 and in 1922 two further recurrent growths were resected by open operation. These were again reported to be benign. In January, 1923, a further recurrent growth was resected and this time was reported to be carcinomatous. In May, 1924, growth was found in the suprapubic scar, which rapidly spread and caused his death in the early part of this month. (I am indebted to my colleague, Mr. Cole, for the notes of this case.)

In connexion with these cases, an interesting report was recently made in the *British Journal of Surgery* by Mr. Maybury.[1]

A growth showing the features of an innocent papilloma was removed from the bladder in October, 1923, but in May, 1924, the patient presented a tumour in the suprapubic scar, which had been increasing in size for three months. This was excised and showed the same features as the original vesical tumour, though it is noted that more active mitoses were present in the cells. In August, 1924, another small nodular mass was excised from the wound which was shown, on section, to be undoubtedly malignant, but at the time there was no recurrence in the bladder. Further recurrence in the suprapubic area took place later.

Including Mr. Maybury's case, it will be noted that in all five the original vesical tumour was examined pathologically and reported to be entirely innocent (in three cases recurrent growths in the bladder were also reported to be innocent), whereas carcinoma developed in the suprapubic scar.

Of the remaining cases in which recurrence was found after operation, five were again under treatment either by resection or by diathermy, and have remained free from further recurrence for periods of 12, 4, 3, $2\frac{1}{2}$ and 2 years. In other words, twenty-six out of thirty-seven are well after one or more operations. I have, however, to report two cases in which recurrent growths were very frequent in spite of free resection and diathermy, both by open operation and via the cystoscope. In these cases no form of treatment seemed to have any effect in arresting further recurrent growths. In both frequent pathological examinations of the tumours

[1] *Brit. Journ. Surg.*, Oct., 1925, p. 381.

removed always showed that there was no evidence of malignancy. One patient was operated upon by others as well as by myself no less than eleven times between 1911 and 1922, and eventually he died of hæmorrhage of the bladder, in April, 1923. The other patient underwent four open operations and numerous treatments by diathermy between 1917 and 1921, when he died of acute intestinal obstruction These two cases caused me very great anxiety, and I think it would have been justifiable in the circumstances to have performed total cystectomy. I should seriously consider the advisability of this operation should it be my lot to come across a case similar to these.

Villous Carcinomata.

This record of the results obtained in the treatment of innocent papillomata may be considered to be poor, but that obtained in dealing with villous carcinomata is even worse. Out of 72 cases which have been under my care, I refused to attempt any radical operation in no less than 37 owing to the extent of the disease, as well as in a further number of cases, not included in my figures, that were seen as hospital out-patients and of whom no exact record is available. Of the remaining 35, in 5 the condition disclosed at operation was found to be more extensive than had been anticipated and was therefore not completed, the exuberant growth being removed and the base fulgurated or cauterized. All of these patients subsequently died. In 30 cases in which radical removal was performed, 2 died as result of operation, 11 remain free from recurrence at periods of twelve years, 2 of six years, 1 of five years, 2 of four years, 2 of three years, 2 of two and a half years, and 1 of one and a half years. Ten cases recurred and all the patients have died of the disease except one, in whom further resection has resulted in freedom from disease for six years. Seven cases cannot be traced and I am afraid it must be presumed that the patients have died from the disease. I am certain that my results in these cases have improved since I have undertaken the more extensive operation of partial cystectomy rather than suprapubic resection; and I look for even better results, for I have not included in my figures any cases operated upon within the last eighteen months. I therefore repeat my plea for a wider operation when dealing with cases in which malignant disease is suspected.

Section of Urology.

President—Mr. R. H. Jocelyn Swan, O.B.E., M.S.Lond., F.R.C.S.

Collection of Thirty-three Vesical Stones.

Shown by Sir T. Carey Evans, M.C., F.R.C.S.

The collection included the following:—

(1) One large mulberry calculus, with a uric acid nucleus and a thin superficial covering of phosphates.

(2) A series of uric acid calculi and mixed urates.

(3) A collection of four medium-sized oxalate stones.

(4) Seven facetted phosphatic stones from the prostatic urethra.

(5) A peculiar flattened calculus, the result of calcification of a papilloma of the bladder.

(6) Large mixed calculus, which had perforated the bladder of a young girl, passing into the vagina and causing a vesico-vaginal fistula.

(7) A series of calculi from the bladders of boys varying in age from 2 to 8 years.

Kidney with Secondary Deposits (following Removal of the Opposite Kidney for Hypernephroma).

Shown by John Everidge, O.B.E., F.R.C.S.

The patient from whom the specimen was removed was shown at the last Clinical Pathological Meeting.

I pointed out then that I had removed his left kidney two years previously for an enormous hypernephroma. At the time I showed him there were obvious deposits of growth in the scar, and the right kidney was greatly enlarged. He had been suffering from attacks of hæmaturia, and there was also chronic urinary sepsis. The general health seemed to be remarkably good.

It will be remembered that I mentioned that, before the operation, there had been a history of ten years' hæmaturia, but this probably could be accounted for, at any rate in part, by a bilharzial infection, which had subsequently died out.

A week or two after I showed him hæmorrhage became very severe, he was re-admitted to hospital, rapidly became uræmic, and died. At the autopsy the kidney now shown was removed, but no secondary deposits or metastases were found, either near the left renal pedicle, or in the lumbar glands, or in any other organ or viscus, apart from the right kidney. The operation scar presented, presumably, implantation deposits.

The specimen shows numerous large deposits of growth, and I am showing sections of these for comparison with sections of the original tumour. It will be noted that there is considerable difference in structure in the two. The section from the left kidney is typical of hypernephroma, while that from the right shows small, round-celled infiltration, irregularly arranged, and resembling a sarcoma more than a hypernephroma.

It was suggested at the last meeting that the condition might be explained by bilateral bilharzia infection of the kidneys, and that, in either kidney, carcinoma had been superadded to bilharzia papillomata. The character of the specimen and the microscopic sections entirely disprove this theory.

Rupture of the Bladder in Acute Gonorrhœa.

By T. E. HAMMOND, F.R.C.S.

A MAN, aged 21, developed a urethral discharge on April 19, 1924, eight days after exposure; gonococci were present. There were no previous urinary symptoms. On April 21 there was painful micturition, and on April 22 there was some difficulty in passing urine. On April 23, while straining to pass urine at 4.30 a.m. he felt something snap in the abdomen and he fainted. There was slight abdominal pain. A catheter passed on this and the following days drew off only a little urine.

He was admitted to the Royal Infirmary, Liverpool, at 6.30 on April 25, sixty-two hours after the onset of the abdominal pain. He was very collapsed and the pulse was 120. The breathing was rapid and shallow. The abdomen was distended and tender, but rigidity was not marked. Free fluid was present, but the bladder was not distended. Rectal examination showed no enlargement of the prostate and no undue tenderness. A No. 18 French gum-elastic bougie passed easily into the bladder and about two ounces of clear urine were drawn off. It was decided that an intraperitoneal rupture of the bladder had occurred.

Under a general anæsthetic the abdomen was opened and large quantities of a turbid fluid were found within it containing only two pus-cells to each microscopical field. There was a rent about 1½ in. long in the superior wall of the bladder; the surrounding tissues did not appear diseased or unduly thinned, and there was no evidence of thrombosis. The rent was sutured with catgut, and the bladder was drained extraperitoneally. The intestines were distended and congested, but there were no adhesions. Slides prepared from the fluid in the peritoneum and from that in the bladder showed no bacteria and the cultures were negative.

Rapid improvement immediately followed the operation, and the wound healed in one month. A cystoscopy at this time showed no ulceration of the bladder and no sacculus. Cysto-urethroscopy showed no lesion of the posterior urethra apart from some inflammation. A cystogram did not reveal any irregularity of the bladder wall. There was no residual urine in the bladder.

Comment.

The rent in the bladder was that which might have been expected to follow a tear in a healthy wall. There was no evidence of disease of the surrounding tissues. It is apparently a case of a rupture of a healthy bladder wall where the only obstruction to micturition was a spasm of the compressor urethræ.

Rupture of the Frenal Artery.

By T. E. HAMMOND, F.R.C.S.

A BOY, aged two years and two months, was admitted to the Royal Infirmary under the surgical unit, on July 22, 1924, having been knocked down by a motor lorry a quarter of an hour previously. He was much collapsed, the pulse was 150, and the clothes were soaked with blood. There was slight bruising of the right side of the scrotum, but none of the penis, and there was no swelling of the perineum. There was a "pin-hole" prepuce and blood was escaping freely from the orifice. The bladder was not distended.

Under a general anæsthetic the prepuce was slit up along the dorsum. No blood was found escaping from the meatus. There was a tear of the frenum and the frenal artery was spurting freely. This was ligatured and circumcision performed. Clear urine was drawn from the bladder by means of a catheter. An X-ray showed that there was no injury to the bony pelvis. The child did very well and was discharged in two days.

Comment.—Severe hæmorrhage from the penis is sometimes seen. During the last year I have come across two cases in which a soft chancre, ulcerating in one case into the glans, and in the other into the frenum, nearly caused death by hæmorrhage. It must be a rare occurrence, for the only injury that followed a severe accident, and which nearly caused death, to be solely a rupture of the frenal artery.

Pyelograms of an Injury to the Kidney.

Shown by T. E. HAMMOND, F.R.C.S.

W. W., AGED 57, admitted to the Royal Infirmary under the surgical unit on May 18, 1925, with the history of an injury to the back. He was somewhat collapsed, the pulse was 100. Tenderness and rigidity over the right lumbar region. No tumour palpable. Urine bright red with blood. As the chest was emphysematous, and he had an attack of bronchitis, expectant treatment was adopted.

May 19.—The urine had become clear and the tenderness over the loin was less marked. The urine was now free from blood.

May 25.—Cystoscopy showed a good efflux from the left ureter, none from the right. Indigo-carmine came from the left kidney in three minutes, none came from the right. A catheter passed up easily into the right kidney, and 6 c.c. of 12 per cent. sodium iodide was injected. The pyelogram shows a rupture of the lower calyx with extravasation of the solution into the perirenal space.

June 6.—Slight pain in right lumbar region. No tumour. Cystoscopy showed an efflux from the right ureter, slightly stained with indigo-carmine after five minutes. Six c.c. of 12 per cent. sodium iodide injected into pelvis of right kidney. Pyelogram showed a more limited and better defined extravasation.

October 2.—Pain in the right lumbar region persisted. Cystoscopy showed efflux from right ureter almost as deeply stained with indigo-carmine at the end of five minutes as that from the left. Six c.c. of 12 per cent. sodium iodide was injected into the right kidney. Pain similar to that complained of was produced. Pyelogram showed no extravasation of the sodium iodide and a normal pelvis of the kidney.

Comment.—These pyelograms show that it is possible for the pelvis of the kidney to be ruptured with extravasation into the perirenal space, but that it is also possible in the process of time for complete healing to occur.

Cystogram of a Growth of the Bladder.

Shown by T. E. HAMMOND, F.R.C.S.

PATIENT, a male, aged 59, was admitted to hospital under the surgical unit on April 24, 1925, with retention of urine due to a stricture of the urethra. The bladder was up to the umbilicus. There were signs of renal failure such as the dry tongue and marked drowsiness, and the blood-urea was 100 mg. per 100 c.c.

It was impossible to pass a bougie through the stricture, so the bladder was opened suprapubically under a local anæsthetic and slowly drained.

May 7. The general condition had now improved and the blood-urea was 50 mg. per 100 c.c. The bladder wash-out was at times blood-stained. Rectal examination showed a rather hard mass in the region of the prostate. A 12 per cent. solution of sodium iodide was injected into the bladder and a skiagram taken. This

showed a markedly sacculated bladder and a growth extending up into the bladder from the region of the prostate. This discovery was confirmed by an examination under an anæsthetic.

Comment.—Cystograms were at first introduced to show the extent of diverticula, which could not be completely examined through the cystoscope. They have been recommended for displaying growths of the bladder, but it is obvious that a cystoscopy will give much more information. In this case, owing to the stricture of the urethra, cystoscopy was impossible. The cystogram was of value since it enabled a diagnosis to be made between a growth of the prostate ulcerating into the bladder and a periprostatitis secondary to the stricture.

Specimen of Cystic Epididymitis.

Shown by F. McG. Loughnane, F.R.C.S.

W. D., aged 67 years, complaining of swelling in the right groin for four years, which has steadily grown larger. He gave no history of injury, and stated he had never been sick in his life.

On examination a large swelling was seen ascending from the scrotum, passing upwards and outwards above Poupart's ligament towards the anterior-superior-iliac spine. The swelling was cystic, it fluctuated, and gave no impulse on coughing. The scrotum was not very distended, and the testicle could be felt. Six medical men saw the patient, and opinion was equally divided as to whether the swelling was a hydrocele or a hernia. A small hernia was present on the left side.

At operation the cyst was found lying under the skin superficially to the inguinal canal. The cyst was removed along with the testicle.

Pathology.—The epididymis is seen to be polycystic, the large cyst containing three pints of slightly turbid fluid, in which are some spermatozoa, but no pus-cells or organisms. The section of the cyst wall shows epithelial cells and fibrous tissue.

Specimen exhibiting Stricture of Ureter.

Shown by S. G. MacDonald, F.R.C.S.

Male, aged 52. The first symptom was an attack of right renal colic in November, 1923. No hæmaturia; radiogram negative; a small shadow present in prostatic region. Patient had a second attack of pain in February 25, and a third in August, 1925; free from pain in the intervals. Patient came under my care in August, 1925, five days after the last attack. The kidney was not palpable, but the loin was tender. The urine was normal. X-rays showed no ureteric or renal shadow, though the same small shadow was present in the prostatic region (no confirmation by rectal or instrumental examination). Cystoscopy showed a normal bladder, catheterization of the left ureter proved the efficiency of the left kidney. A catheter passed along the right ureter stopped 5 in. from the ureteric orifice, and would go no further; the kidney was injected with sodium bromide (pyelogram by Dr. Coldwell and Dr. Allchin shown); this revealed a dilated kidney pelvis and stricture of the ureter just below the pelvic brim. In the specimen the ureter is dilated below as well as above the stricture.

Kidney showing Renal Stone and Hypernephroma.

Shown by S. G. MacDonald, F.R.C.S.

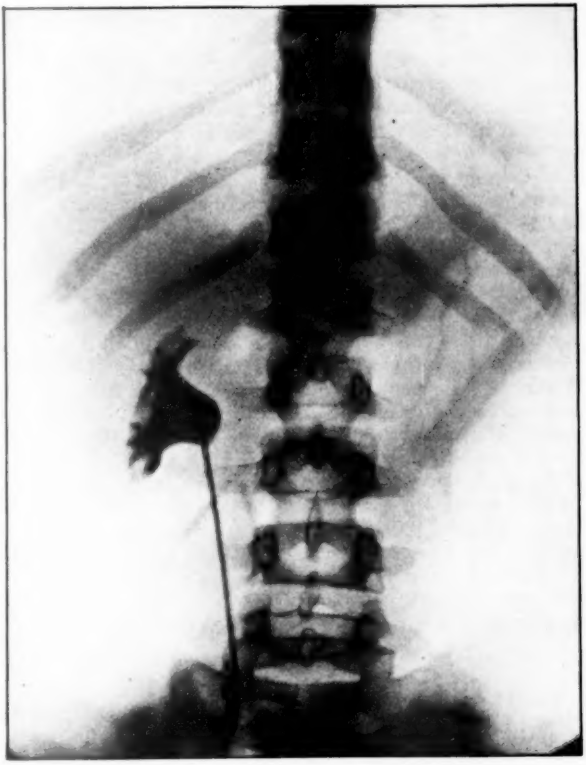
Male, aged 55. Sixteen years ago right nephrolithotomy. Twelve months ago right renal pain and hæmaturia; intermittent pain since. Patient came under my care in July, 1925; he had an infected right kidney, and, in addition, a small phosphatic

stone in the bladder. Operation: Litholapaxy followed by right lumbar incision; upon the kidney being exposed the hypernephroma was seen and the kidney removed.

Specimen of Congenital Hydronephrosis.

Shown by A. CLIFFORD MORSON, F.R.C.S.

PATIENT, a boy aged 13. History of intermittent pain in the region of the umbilicus for the past seven years. He was in a medical ward six years previously for similar pain, when the condition was diagnosed as intestinal colic.



Examination of urine showed neither abnormal constituents nor bacteria to be present. Pyelography showed left kidney to be normal and right kidney hydronephrotic with failure of development of the calices.

Operation: Right nephrectomy; convalescence normal.

Papilloma of the Renal Pelvis diagnosed by Pyelography.

By Sir JOHN THOMSON-WALKER, F.R.C.S.

Dr. M., AGED 65, complained of recurrent attacks of symptomless hæmaturia, commencing April, 1924, the latest attack being some months previous to examination.

On examination (May 12, 1925), there were no symptoms, and nothing abnormal was found on palpation or rectal examination. The bladder was normal, the ureteric orifices healthy and the effluxes clear.

A catheter passed 18 cm. up the right ureter and was then arrested. The urine obtained was tinged with blood, faintly alkaline, contained a heavy trace of albumin, a number of transitional cells and a few leucocytes, but no renal elements or crystals. The urea content was 0·7 per cent.

A catheter was passed up the left ureter 30 cm. and clear urine was obtained; this was faintly alkaline, contained a minute trace of albumin, a very few blood discs and transitional cells, but no renal elements or crystals. The urea content was 1·2 per cent.

On the reduced urea percentage on the right side I selected the right kidney for pyelography. Some pressure was required in order to introduce sodium bromide solution into the right renal pelvis.

The pyelogram showed that the end of the opaque catheter was arrested at the level of the upper border of the transverse process of the fifth lumbar vertebra; the ureter above this was filled with opaque material and it curved outwards to form a loop to the point at which it entered the renal pelvis. There was a shadow-track curving upwards from this and fading into a granular opacity beginning at the level of the lower margin of the third lumbar vertebra and passing up to the body of the first lumbar vertebra. Outward from this granular opacity there were situate two dilated clubbed calices at the level of the third lumbar vertebral body, and another round, dilated calyx less defined was situate at the level of the disc between the first and second lumbar vertebræ.

The diagnosis of papilloma of the renal pelvis was made from the pyelogram, and I removed the kidney on June 15, 1925. The operation specimen showed that the pelvis of the kidney was filled with papillomatous growth arising from the mucous membrane lining the lower and outer wall. The upper and lower calices were much dilated, but did not contain growth.

The naked-eye and microscopical appearances are those of a simple papilloma, and there is no evidence of infiltration of the wall of the pelvis.

Two Cases of Hydronephrosis Complicated by Obstruction to the Ureter by Renal Blood-vessels.

By H. P. WINSBURY WHITE, F.R.C.S.

Case I.—Patient, a female aged 46, who complained of attacks of pain in the left side over a period of eighteen years, commencing during a confinement. At first there were many months' interval between the attacks, but latterly they occurred much more frequently.

The diagnosis was made by means of an ordinary routine examination of the urinary tract, terminating with the intravenous indigo-carmine test, which showed

the right kidney to be functioning normally, while no dye was excreted from the left side in fifteen minutes.

The history was taken into consideration with these findings, and the diagnosis of left-sided hydronephrosis was made. There was no palpable swelling in the left renal region. I removed the left kidney in due course with satisfactory result.

On dissecting the specimen after removal, an atrophied kidney, somewhat smaller than normal, with a marked distension of the pelvis, was noted. The special point of interest lay in the fact that the enlarged pelvis had become pushed forward over the inferior renal vessels and had dragged the ureter with it. This led to the ureter becoming compressed between the vessels and the distended pelvis. The vein, as well as the artery, was taking part in the compression. There was an inflammatory thickening at the upper end of the ureter—no doubt the original cause of the ureteral obstruction, and probably resulting from the pyelitis of pregnancy which had occurred eighteen years before.

Case II.—A male, aged 43, who had complained of attacks of pain in the left side for four years. The diagnosis of left hydronephrosis was made in the same way as in the previous case.

On removing the left kidney and examining the specimen it was found that, as in the previous example, the distended pelvis had passed forward, above the inferior renal vessels, dragging the upper part of the ureter with it and causing it to be compressed on to the distended pelvis by the vessels in question. On dissecting these it was found that they were four in number, two of which were normal, whilst the other two were abnormal in the sense that they entered directly through the parenchyma of the lower pole.

Both of these specimens are of interest in showing the secondary part played by certain renal vessels in hydronephrosis, especially with regard to normal vessels. Further, they supply evidence in disproof of the necessity for any abnormality of the involved vessels, or for these being an ætiological factor in the causation of the disease.

Case of Hydronephrosis with Intermittent Hæmaturia as Outstanding Symptom.

By H. P. Winsbury White, F.R.C.S.

Patient, a female, aged 56, who complained of intermittent passage of blood in the water for the previous ten months accompanied by a dull aching pain in the right side.

When I saw the patient the bleeding had been noted continuously for the past week and she was showing signs of anæmia from loss of blood. Radiograms were negative to the presence of stone, while cystoscopy revealed the fact that the blood was coming from the right ureter. Indigo-carmine intravenously injected indicated that the left kidney was functioning normally, whereas no dye had appeared from the right ureter in ten minutes. On palpation, the right kidney was felt to be slightly enlarged.

I cut down on the right kidney expecting to find a renal growth. It was seen at once, however, that I was dealing with a simple hydronephrosis. The kidney was removed. On opening the organ subsequently a widespread condition of inflammation was found throughout the pelvis and calices, the blood-vessels of these structures being markedly injected. This was obviously the source of the bleeding. The inflammatory change involved the attached portion of the ureter, providing some stenosis which would explain the hydronephrosis.

A catheter specimen of urine from the bladder revealed a slight amount of pus, enterococci, streptococci, and diphtheroid bacilli.

Mr. E. T. C. MILLIGAN, F.R.C.S., showed specimens of (1) Epididymitis following vasectomy; (2) ulcers of stomach after prostatectomy.

Mr. R. OGIER WARD, F.R.C.S., showed a specimen from a case of fibrin calculi, an account of which will be published in the *British Journal of Surgery*, accompanied by illustrations.

Section of Urology.

President—Mr. R. H. Jocelyn Swan, O.B.E., M.S.Lond., F.R.C.S.

DISCUSSION ON PYELOGRAPHY.

Mr. Girling Ball

said that in order to introduce the opaque fluid he used a large record syringe with a fine-bored needle so as only to permit of the slow introduction of the fluid. He usually used sodium bromide, the iodide occasionally being substituted.

He showed three pyelograms to illustrate different points.

The first was from a man complaining of repeated attacks of renal colic without other symptoms. He had been radiographed on no less than eleven occasions without showing evidence of a stone being present. The pyelogram showed a picture typical of the early hydronephrosis which he associated with the presence of a stone. After the fluid had been drained off a further picture was taken which demonstrated a round shadow that proved to be the outline of a pure uric acid calculus. In his experience it was uncommon for stones to be outlined in this way.

The second case illustrated a point in the differential diagnosis beween small renal calculi and calcareous lymphatic nodes. Overlying the area of the left kidney fluffy shadows were seen, about three in number, which from their appearance were thought to be tuberculous nodes. This was especially the case, as the girl had no urinary symptoms, beyond a dull pain in the loin; moreover, the lateral skiagram demonstrated the situation of the shadows well in front of the spine and away from the usual site of the kidney. A pyelogram showed that the kidney was placed in this situation, that it was the seat of a calculous hydronephrosis, and when the fluid was run out, the shadows were seen to be broken up into a great number of smaller shadows, which at the operation proved to be multiple calculi.

The third case was one of hæmaturia associated with renal colic. An X-ray picture demonstrated a shadow in the region of the kidney looking like a branched renal calculus. The pyelogram, however, showed a normal renal pelvis; this, in a stereoscopic picture, was seen to be placed well behind the original shadow, which at the operation was found to represent a mass of calcareous glands that had involved the ureter.

Mr. T. E. Hammond

pointed out that the solution injected, 12 per cent. sodium iodide, was of very high concentration and might produce a severe reaction in the kidney. Possibly this might be due to an idiosyncrasy to the drug; in one such case he had seen 10 gr. of iodide given by the mouth three times daily produce iodism in two days. The fluid should be aspirated immediately the skiagram had been taken and the pelvis washed out with sterile saline. At times, irritability of the bladder followed when oxycyanide of mercury had been used to wash it out. This might possibly be due to the formation of sodium mercuric iodide, which was very irritating to the bladder even in a strength of 1 : 10,000. When saline was used instead of the oxycyanide this irritability did not occur. Slides from three cases were demonstrated.

Case I.—A woman, aged 40, was admitted with abdominal pain of such severity that a diagnosis of a perforated gastric ulcer had been made. There was no tenderness and no rigidity, but a large tumour was present in the left lumbar region. The pyelogram showed no filling defect. As a tentative diagnosis was made of torsion of the spleen the abdomen was opened. The spleen was found to be normal, but there was a large retroperitoneal tumour surrounding the left kidney. The pain was probably due to hæmorrhage into the tumour. Her condition was too serious to allow removal of this growth. A further operation was later refused. When she was admitted twelve months later the pyelogram showed no filling

defect of the pelvis, which was pushed downwards, but there was marked kinking of the ureter. Operation was again refused.

Case II.—A woman, aged 40, had pain on the left side for five years. The ureteral catheter did not pass into the pelvis of the kidney. When the fluid was injected, pain was produced similar to that of which she had already been complaining. The pyelogram showed a kink in the ureter. One week later, under an anæsthetic the catheter passed into the pelvis of the kidney and was retained in position for twelve hours. This was followed by complete disappearance of the symptoms.

Case III.—Renal colic of five months' duration with hæmaturia.—Cystoscopy showed blood escaping from the left ureter. A No. 12 catheter was obstructed 8 cm. from the orifice, but a No. 10 catheter passed up easily into the kidney. The pyelogram showed a dilatation of the ureter above the pelvic brim, but there was, for a length of half an inch, definite narrowing below this point. This was found at the operation to be due to compression of the ureter by the uterine artery, above which there was a small uric acid stone.

Mr. Alban Andrews

showed pictures of two cases.

Case I.—A man, aged 32, with congenital cystic kidneys; he had suffered from hæmaturia from the left kidney for a week, and one or two similar attacks during the preceding six months. Both kidneys were palpable, but the left was larger and more irregular.

Case II.—A youth, aged 20, who had had one attack of pain in the right loin four months before being seen. Other symptoms were occasional cloudiness of urine, thirst, attacks of flushing, and swelling under the eyes. Tests of function were quite satisfactory on the left, but poor on the right side. At operation adhesions were found between the ureter and the lower pole of the kidney, with kinking.

Sir John Thomson-Walker

said that it was necessary to be careful about diagnosing disease from the presence of elongated calyces. Similar appearances might be presented by a partly filled normal pelvis and other causes, without disease being present.

Dr. Gilbert Scott

pointed out how important interpretation was and how difficult it was to decide whether any abnormality seen in the pyelogram was but a variety of the normal, or a pathological condition. Slight variations, such as a partly filled pelvis, might be due to faulty technique. He found it useful, when in doubt, to imagine that it was his own kidney on which he was pronouncing judgment. Technique should be as simple as possible; the whole process should be completed within half an hour. The catheter should be passed in the room in which the photograph was taken, and three plates exposed—one before the injection, one when the pelvis was full, taken at full inspiration, and the third while the kidney was emptying, at full expiration. On comparison the two latter gave an idea as to whether the kidney was fixed or not. The third radiograph might give evidence of a stone which the second did not show. Owing to staining of a transparent stone by the opaque fluid, this occurred more readily under the use of sodium bromide than under that of collargol. A lateral view failed when it was most wanted for localization of shadows in the kidney region; a far better method of localization was to take two radiographs, one in full inspiration and one in full expiration, noting whether the shadow moved with the kidney in all directions. He enumerated the following cases in illustration:—

(1) Double ureter and pelvis on both sides with a hypernephroma of the lower pole on one side, the lower pelvis not functioning at all.

(2) A slide showing the opaque substance in the tubules; it caused no ill-effects; some kidneys took the stain very easily.

(3) A pyelogram showing variations from the normal: (*a*) very slender major calyces, and (*b*) a number of minor calyces.

(4) Early hydronephrosis, with no blunting of the calyces. Increased breadth of the calyces, and increased size of the pelvis without blunting of the calyces was not an unusual condition seen in early hydronephrosis.

(5) Elongated calyces in a case of hypernephroma of the upper pole.

(6) A similar hypernephroma showing the lower calyces dilated, while the upper had disappeared altogether.

(7) A similar disappearance of the upper calyces in what proved to be a benign papilloma.

(8) A large calcareous renal growth, the microscopical diagnosis of which was doubtful.

In the last four cases the diagnosis was difficult, as they were atypical. The important thing was to be certain that a pathological condition was present; this would justify an operation—the exact nature of the lesion was of less importance.

Sir JOHN THOMSON-WALKER

pointed out certain characteristics of the normal pelvis. The catheter should pass into the upper calyx. If it raised the roof of the pelvis, this indicated a displaced or abnormal kidney. In the normal pyelogram it was not possible to tell exactly where the pelvis ended and the ureter began. There was a curve between the upper ureter, the lower border of the pelvis, and the lower calyx; in the abnormal kidney this curve became diminished or angular in proportion to the dilatation or displacement.

Mr. J. SWIFT JOLY

showed a series of slides:—

(1) A doubtful shadow at the lower pole of the kidney. The pyelogram showed that it was due to a collection of small stones in the lower calyx. In this kidney there were no primary calyces, all were of the secondary type.

(2) A doubtful shadow, which was shown to be a stone in the lower half of a double kidney.

(3) A doubtful shadow, which was proved to be due to a mass of tuberculous glands in connexion with the colon.

(4) A localized dilatation of the ureter five months after an uretero-lithotomy.

(5) A case of double ureter.

(6) Three cases of hæmaturia with few localizing symptoms, shown to be due to hypernephromata.

(7) A case of renal tumour with marked distortion of the ureter.

(8) A huge embryoma.

(9) A case of a staphylococcal abscess of the kidney opening into the middle calyx.

(10) A case of polycystic disease in a boy aged 15.

(11) A pyelogram of a tuberculous kidney.

(12) Two cases of rotation of the kidney, one caused by an abnormal artery going to the upper pole, and the other by a similar artery going to the lower pole.

(13) Two cases showing the results of nephropexy.

(14) An oxygen pyelogram of a huge hydronephrosis, which had been operated on as a mesenteric cyst.

(15) A large hydronephrosis in one half of a horseshoe kidney.

(16) A case suspected of being a horseshoe kidney, but shown by the pyelogram to be two separate organs, the right being displaced and rotated by an abdominal new growth.

Mr. F. McG. LOUGHNANE

said that he had had a number of cases of mobile kidney with no marked symptoms except, occasionally, frequency of micturition or painful micturition, or slight right-sided abdominal pain. All had shown a definite hydronephrosis on pyelography. He showed slides of two such cases of pain in the right iliac fossa, one of which was taken four years after appendicectomy. Injection of sodium iodide in each case caused the characteristic pain. He also exhibited a slide of perirenal oxygen inflation, showing the right kidney swivelled round the spine, and another showing the absence of hydronephrosis fifteen years after nephropexy.

Mr. H. Courtney Gage

said that when it was desirable to obtain in the radiograph an outline of the kidney and a shadow of a doubtful stone, a solution of sodium iodide not stronger than 7 to 10 per cent. should be used. This gave a thin radiograph, but it was of good diagnostic quality. The weak solution was easily penetrated and detail obtained through it.

With strong solutions, 25 per cent., the technique should be changed to one of higher penetration; more contrast would be obtained, but the renal outline would often be sacrificed to obtain this. If the higher penetration was not used with the strong solution, the normal umbilication at the ends of the calyces would often be obscured by the density of the shadow and an apparent blunting appear where it did not exist. Abnormal shadows, except those cast by very opaque bodies, might not appear in this quality of negative. The technique to be employed would be dictated by the nature of the case to be investigated.

A false deformity of the ureter was often shown in films taken at the end of deep inspiration. For this reason exposure should be carried out at the end of expiration or after a small breath only.

Nervous patients might be quietened by instructing them to breathe through the nose. If pain should be produced it would be better borne while the patient was breathing rapidly through the open mouth. Breathing must cease, of course, for the duration of the exposure.

There should be a preliminary examination before the pyelography.

Mr. Gage showed a slide illustrating the value of pyelography, with the patient in the erect posture, to determine the position of the kidney.

Mr. A. Clifford Morson

said the correct interpretation was very difficult and required close co-operation between radiologist and urologist. The clinical picture was as valuable as the radiogram, and the pain produced by fluid injection should be compared with the pain of which the patient complained. He always used sodium iodide from 15 to 25 per cent., and had given up the use of an antiseptic with it, owing to the irritation caused by oxycyanide of mercury. He showed slides illustrating three cases:—

(1) Case of painless hæmaturia. Pyelogram showed one kidney normal with distended calyces, and the other with something protruding on the inner side of the pelvis; this proved to be a squamous-celled carcinoma.

(2) Case of stony hard swelling in the left loin, with a shadow over the iliac crest. The pyelogram was not of much help; it showed a little stunting of the lower calyces. Operation revealed a very large hydatid cyst of the lower pole, with calcified wall.

(3) Case of painless hæmaturia in a boy, aged 17, with both kidneys palpable. Pyelography showed an abnormal bifid pelvis, with elongated calyces, probably a congenital cystic condition.

Professor E. B. Fuller (Cape Town)

said that very valuable information as to mobility was obtained by screening the kidney before the injection, watching the fluid go in and the way the pelvis distended. This enabled the best position to be obtained for centring the photograph.

Mr. C. A. R. Nitch

asked for an opinion on the case of a girl, aged 10, with colon bacilluria and retention, of six months' duration. Daily catheterization had reduced the retention to 8 oz. of residual urine. A skiagram taken after injection of 8 oz. of sodium bromide into the bladder showed right hydro-ureter and hydronephrosis. A pyelogram of the left kidney was normal. The retention was considered to be due to inflammation and œdema of the neck of the bladder, but if this was the primary cause, why was the dilatation limited to the right side?

Mr. Winsbury White

showed slides and drawings illustrating the following cases:—

(1) Marked looping of the ureter with considerable pelvic distension. Although the catheter passed up the normal distance no urine could be drawn off. He pointed out that there was a danger in running in the pyelographic fluid, it being known, as in this case, that it could not be extracted.

(2) Two other cases in which the same danger was indicated, as no flow of urine could be obtained after the passage of the ureteral catheter. The diagnosis of hydronephrosis was effected in each case, however, without having to resort to pyelography. It was accomplished by means of the indigo-carmine test, after excluding other conditions, with the usual routine examination of the urinary tract.

(3) A stricture in the region of the pelvo-ureteral junction with an early dilatation of the renal pelvis. The catheter could not be made to pass the point of narrowing as seen in the slide. On palpating the ureter after exposing the kidney at operation, the ureteral stricture could be identified as a zone of thickening about 1 in. in length. It was dealt with successfully by dilatation with bougies after incision of the ureter.

[*February* 25, 1926.

Testing of Renal Function in Relation to the Treatment of Renal Disease.

By Hugh MacLean, M.D.

(ABSTRACT.)

It was important to reduce the number of tests to a minimum, and experience showed that all necessary information could be gained from the estimation of the blood-urea and the urea concentration in the urine. The blood-urea was variable; 20 mgm. for 100 c.c. was about the normal for young people, but it might reach 60 mgm. in healthy people past middle life. Many conditions other than kidney trouble could increase it, and, taken alone, it was unreliable, except that if it were normal the kidneys could not be in a very bad state. The water test, extensively used in America, gave much trouble to the patient, but no more information to the doctor. The simplest test of all was to starve the patient of fluid from 15 to 20 hours, and then estimate the urea in the urine by the hypobromite method.

Albuminuria and Hæmaturia.—Albuminuria of a functional nature was fairly common in young people; it hardly ever led to nephritis. The patient was usually rather overgrown and neurotic, and the urine generally showed no casts. In these subjects albuminuria, and even casts, might be present, without any symptoms of disease, and with repeatedly normal readings in the urea tests. Another type of patient passed albumin, casts and blood; definitely there was something wrong, probably a mild attack of acute nephritis. In recovered cases of nephritis the patients might improve in their urea concentration from 1·3 to 4 or 4·5 per cent., and still have some albuminuria. Continuance of the albuminuria was, therefore, no indication that the kidney was affected by chronic disease. Some perfectly healthy people continued to pass albumin for twenty or thirty years after an attack of scarlet fever. It was important to examine the centrifugalized deposit. He cited the case of a small boy with curious attacks of pallor, pain, and some difficulty of micturition. There was no evidence of nephritis, but the centrifugalized deposit of his urine was full of cystin crystals.

High Blood-pressure and Nephritis.—Boys of 16 to 19 often passed a little albumin, and had a blood-pressure of 155/80. In most of these cases there were no subsequent developments. Many healthy people had abnormally high blood-pressures without symptoms of ill-health. If the kidneys became involved when

the high pressure occurred with arterio-sclerotic changes, the end of the patient's life was not far off, but they often escaped, even when the vessels of the arm and other regions were tortuous and hard.

Treatment.—Nothing much could be done in acute chronic nephritis, except to put the kidneys under the best possible conditions. The patient should be kept warm, and given glucose by the mouth. Many who could not drink milk could take a 50 per cent. solution of glucose, which passed so quickly into the intestine that a certain amount was retained even if the patient vomited. Diuretics were of no use; there was already an excessive amount of urea, which was the best diuretic known. In the parenchymatous type, where the patient had a tremendous œdema and was passing protein in the urine, a good solid diet with plenty of protein was beneficial. 20- to 30-grm. doses of urea given two or three times a day for a few days sometimes promoted diuresis. Baths were sometimes helpful, and nicking the skin of the swollen limb with a knife was better than inserting Southey's tubes. There was no evidence that protein did any harm whatever. Animal experiments showed that a rabbit would not develop nephritis, even on a diet containing 70 per cent. of protein, if it were also given green vegetables in minute amounts. It was better to reduce the protein in very acute nephritis, but in advanced chronic cases it did not matter. It was wrong to interfere with a high blood-pressure; the body became accustomed to it, and the patient was better left alone unless it was causing definite symptoms.

Discussion.—Sir JOHN THOMSON-WALKER said that he was glad to have the opportunity of reaffirming his confidence in the urea tests of the renal function. The other tests that were still used were the colour tests, namely, phenolphthalein and indigo-carmine. There was a great difference between the problems which the physician and the surgeon set out to investigate by means of the renal function tests.

The surgical problem in the majority of cases included two factors, one temporary and the other permanent, which influenced the renal function. There was temporary interference with the function arising from existing urinary obstruction and back-pressure, and a permanent interference with the renal function due to chronic interstitial nephritis. By the use of proper surgical measures, the back-pressure was removed and only the permanent changes, if they existed, would remain. In 80 per cent. of the cases which were tested in surgery, the temporary reduction of the function was the principal factor, the permanent reduction of function being negligible. There was therefore a very rapid and conclusive demonstration of the value or otherwise of the tests of the renal function.

The phenolphthalein test aimed at great accuracy. A known quantity of the dye was injected and was excreted by the kidneys alone. A definite percentage of the quantity injected should be recovered in the urine during the first two hours. Measurement was made against a standard solution in a colorimeter. Unfortunately there were unaccountable variations in the excretion that destroyed confidence in the test, and he had given up using it for some years.

Indigo-carmine was excreted by other organs than the kidneys and there was no possibility of accurate measurement of the excretion. The depth of staining was only a matter for individual opinion. If there was deep staining of the urine occurring rapidly, it was considered that the renal function was good, whereas if there was a poor, delayed staining, the function was impaired. On the whole it was an easily applied rough test, a positive result being important, whilst a negative result was of little value. Recently he had noticed that alkaline urine had the effect of partly bleaching the colour and he investigated this point. In alkaline urines, although the alkalinity was due to bladder and not to renal disease, the colour was pale green. Where the urine was acid, and a deep blue was obtained by the injection of indigo-carmine, the colour was changed to pale green by the addition of an alkali to the urine. The administration of an alkali by the mouth had the effect of reducing the depth of colour of the urine charged with indigo-carmine. These observations, which had not, so far as he knew, been previously made, still further reduced the value of the indigo-carmine test of the renal function.

The principal urea test was the forced urea-elimination test or urea-concentration test, and in the majority of surgical cases no other was required. One of the greatest advantages of this test was that it forced the existing renal function to its highest point. There was in the

normal kidneys an active and a potential renal function, the latter amounting to over 50 per cent. of the total. The forced urea elimination showed up the potential renal function and demonstrated how far it had been destroyed. This was what was desired by the surgeon, who proposed to throw a strain on the renal efficiency by performing an operation. Various percentages of urea in the urine during the test were given as representing the normal and damaged function. These were of the utmost importance as a means of placing the state of the kidneys before the surgeon. They could not, however, be made the basis of rules by which the surgeon was told whether it was safe or unsafe to operate or whether an operation was to be done in one way or another. These were matters which were decided by the surgeon, and which varied with the individual surgeon, depending on his experience and skill and the surroundings in which the patient was placed and the skilled attention he would receive after the operation. It might be said quite definitely that one surgeon could operate with safety where the renal function was low, where another surgeon could not; and that the same surgeon might operate in safety with good post-operative conditions, where he could not venture to do so when the post-operative conditions were not good. He (the speaker) believed, therefore, that rule-of-thumb statements in regard to safety or danger of operation in relation to the renal function were worthless to the experienced surgeon although they might help the novice.

Examination of the blood-urea was a most important addition to the urea-concentration test but it only became valuable when the renal function was seriously impaired (50 per cent. or over). It was of great value in watching the progress of a case, where the renal function was known to be seriously impaired, such as cases in which the bladder had been drained for chronic urinary obstruction with signs of uræmia. Then it gave more information than did the urea-concentration test. Cyphers made by combining the figures of the blood-urea and the urine urea were of no real value. The important information to have in deciding as to an operation was the amount of urea excreted and the amount retained, set out in separate figures.

Dr. J. W. McNEE agreed that it would be a pity to restrict tests for renal function to two in number, especially in view of our very defective knowledge of renal physiology. All the present tests must be recognized as crude, and extra-renal factors such as diet, hepatic insufficiency and cardiac failure influenced the results considerably. He regarded the estimation of the blood-urea as very valuable, and stressed the frequent repetition of the observation as a guide to the progress of the case. The urea-concentration test was in his view of less value, and could not always be relied upon to give the information desired. He thought the "water-concentration" test easy to carry out, and often of considerable assistance. It showed whether the kidneys had lost their important power of concentrating the salts in the urine, and was of definite help in distinguishing between primary cases of high blood-pressure and chronic nephritis.

Dr. McNee next referred to the clinical progress of acute nephritis, and said that rapid improvement often occurred for some weeks after the onset, until all œdema had gone, and the albuminuria was reduced to less than 1 per cent. At that stage, however, progress was often arrested, and albuminuria and tube-casts might persist for many months. The attitude of the physician should be to expect complete cure in the majority of cases of acute nephritis, and not to relax care until other evidence showed the development of progressive nephritis. A valuable test and sign of this misfortune was the appearance of fatty casts containing doubly-refracting cholesterol-ester fat.

He (Dr. McNee) said that he regarded diuretics as "hit-and-miss" drugs, possibly entirely non-specific, and his view was that when used, the simple ones, which could do least harm, should be given a fair trial in turn.

As regards diet, he had found that the low protein diets given in America yielded better results in treatment than the more haphazard dieting of nephritic cases in this country. Chronic cases, however, often did best on a mixed average diet.

Mr. C. A. R. NITCH said that for several years the only tests he had employed to estimate the efficiency of one or both kidneys were the following:—

(1) The urea-concentration test. (2) Elimination of indigo-carmine. (3) The blood-urea test. (4) Clinical manifestations.

He only employed indigo-carmine for estimating the function of one kidney when catheterization of its ureter was impossible or inadvisable. For this purpose the dye was useful but the test was not very delicate and did not indicate slight impairment of the kidney

as did the urea-concentration test. Its value depended more on the amount of dye excreted than on the precise time of its appearance, i.e., slight delay and good coloration indicated an efficient kidney.

The urea-concentration test was the *chemical* test on which he placed the greatest reliance. It was easily applied, the margin of error was comparatively small, and if used intelligently it was a very reliable guide to the function of the kidneys.

The technique was the following :—The urea was given one hour after a meal consisting of a small cup of tea and two pieces of toast and butter. No more fluid should be taken until the completion of the test. If there was any residual urine the bladder was emptied with a catheter which was then retained until the three specimens of urine had been collected. Occasionally the urea caused pronounced diuresis and the percentage excreted was therefore lower than normal. This lowered excretion might safely be attributed to the diuresis and the percentage of urea taken at a higher figure. The following simple equation would give a correct reading, the average excretion of urine in the second hour being taken at 120 c.c., and the actual amount excreted by the patient being x c.c. :—

$$\text{Percentage of urea in } x \text{ c.c.} \times \frac{x \text{ c.c.}}{120 \text{ c.c.}} = \text{true urea concentration in second hour.}$$

When the test was employed in estimating the function of one kidney only, the ureter was catheterized 1½ hours after the dose of urea, and 2 c.c. of urine were collected. With this small quantity Dr. De Wesselow had always been able to give him (Mr. Nitch) a reliable estimate of the urea concentration.

Blood-urea.—The range of normality of the blood-urea was so great that this test was of little value unless the urea retention was above 50 mgm. per 100 c.c., when it pointed strongly to renal deficiency. He therefore regarded any figure above 50 as a contra-indication to an operation.

Clinical Manifestations.—The discussion of these he had left to the last, but in his opinion they were just as important, and in some instances even more important than chemical tests. Clinical manifestations such as excessive thirst, a distaste for meat, a dry tongue and a sallow complexion, when considered in conjunction with the chemical tests gave an indication of the renal function which was on the whole so reliable that the surgeon who studied them carefully would seldom lose a patient from uræmia after an operation on the urinary tract.

The capacity or otherwise of a patient to resist the spread of sepsis to the kidneys after an operation such as prostatectomy was a factor which might upset the calculations of both surgeon and biochemist, but in these cases death was due to pyelonephritis and not to failure of a previously defective kidney.

The urea-concentration test was a great help, but it was not infallible, as Professor MacLean had pointed out. A good concentration did not necessarily imply a successful surgical issue, and, conversely, a poor one did not indicate a certain fatality, owing to the many other factors which must be taken into consideration. The importance of combining clinical and chemical evidence was well shown by the following brief notes of two cases :—

Case I.—Enlarged prostate. Six oz. residual urine. Urea concentration 1·5 per cent., 1·6 per cent., 1·9 per cent. General condition good. Tongue moist. Appetite good, *but* complexion sallow. Preliminary drainage. Uræmic for four days after drainage.

Case II.—Enlarged prostate. Colon bacilluria. Before drainage, urea concentration 1·4 per cent., 1·6 per cent., 1·6 per cent. Vaccine. Three months later clinical condition excellent; gained 1 st. in weight. Urea concentration, 0·55 per cent., 1·25 per cent., 1·5 per cent. Successful prostatectomy.

Dr. GEOFFREY EVANS pointed out that the use of these tests was to test renal function; and that they were only of limited value in the diagnosis of renal disease, namely, in those cases in which renal disease was so far advanced that reserve of kidney function was limited. It followed, therefore, that they were of little use in the diagnosis or prognosis of early kidney disease. Nephritis might go on for five years without failure of renal function. The symptoms of renal function failure or of renal toxæmia probably appeared earlier than did the signs of renal function failure as demonstrated by chemical tests. Even earlier than symptoms, and of first importance in the diagnosis of renal disease, were the physical signs such as hæmaturia and hæmorrhages elsewhere in the body. Marked albuminuria was also a significant indication of active disease; and when looking for casts the importance of taking a fresh specimen of urine, and one not very dilute, was emphasized.

The most important part of the treatment of active nephritis was probably rest in bed, even up to twelve months if necessary; the criterion of recovery being the disappearance of

red blood-corpuscles from the urine. His (the speaker's) experience had been that once a patient was well he remained well, and that in those cases in which relapse occurred healing had never been complete.

As regarded other points in treatment Dr. Evans referred to the need of removing obvious septic foci. In regard to diuretics he suggested that too little was known about them to allow of any definite pronouncement. Diuresis was largely dependent on extrarenal factors such as circulatory efficiency; and even diuretics might exercise their primary action on extrarenal tissues, as was suggested by the work of Dr. George M. Curtis,[1] who had experimented with a diuretic,—euphyllin,—which seemed to act by causing a discharge of chlorides from the tissues of the body and their consequent accumulation in the blood, this accumulation of chlorides setting up the diuresis.

[1] *Biochem. Zeitschr.*, 1925, clxiii, p. 109.

Section of Urology.

President—Mr. R. H. Jocelyn Swan, O.B.E., M.S.

Remarks on Four Cases of Horse-shoe Kidney.

By R. H. Jocelyn Swan, O.B.E., M.S. (President).

The fusion of the two kidneys into one mass may be present in various forms, of which the horse-shoe kidney is the most common. In a series of over 18,000 post-mortem examinations at various hospitals it was found to occur in roughly 1 in 1,000 cases and I need hardly remind you that the usual form of horse-shoe kidney is that in which the lower poles are joined by a transverse band of tissue passing in front of the aorta and vena cava and formed by a variable thickness of renal tissue. The ureters nearly always pass down in front of this connecting structure, the renal pelvis being placed somewhat anteriorly, though variations in this occur. The renal vessels show greater variety, coming off from the aorta and often being supplemented by arteries to the lower pole or to the connecting band coming off from the common iliac arteries.

Although it is generally accepted that a solitary or congenitally single kidney is more prone to be attacked by disease such as calculus or tuberculosis, I do not think that there is any evidence to show that a horse-shoe kidney suffers from the same tendency. Cases have been recorded in which both ureters have contained calculi or in which the lateral portion of a horse-shoe kidney has been the seat of tubercle or malignant growth. But these are very rare and I think that we may look upon a horse-shoe kidney as a deformity in which the two relatively normal organs are by an accident of development joined at the lower poles.

The cases which I now bring forward are those in which accident or disease has occurred in my own personal observation in four cases of horse-shoe kidney, and it is a curious fact that three of them should have come under my observation during the short space of eleven months.

Case I.—The first case was in 1905, when I saw a young man who two days previously had fallen in a gymnasium across the parallel bars, striking his side. He had pain, and on the next occasion of micturition, found that the urine was deeply stained with blood. The pain in the side became more acute and when I first saw him there was an ill-defined tumour in the right loin with considerable bruising, and the urine was deeply stained with blood. I treated him with complete rest and with morphia, but in twenty-four hours the swelling had increased in size and he was showing general signs of hæmorrhage with pallor and a rising pulse. Having diagnosed a laceration of the right kidney, I decided to cut down upon it to arrest the hæmorrhage or to perform nephrectomy if necessary. After turning out much blood-clot I found difficulty in exposing the kidney, but subsequently I found a deep laceration in what at first appeared to be the lower pole. I then found that I was unable to bring the kidney to the surface without risk of increasing the laceration, and further examination showed that I was dealing with a horse-shoe kidney which had become torn at the junction of the lower pole with the transverse band of union. Suture of the tear in the depth of the wound was difficult and the patient's condition was none too good, so I plugged the lacerated area in the kidney with gauze packed firmly, and sewed up the greater part of the parietal wound. The gauze was removed after three days without further bleeding and the patient rapidly got well.

Case II.—Calculi in a Horse-shoe Kidney.—I did not meet with another case of horse-shoe kidney until February, 1923, when Dr. B., aged 31, was sent to me by our Secretary,

Mr. MacDonald, during the time he was laid up. This patient gave a history of renal colic in 1914 and again in 1917, when he was invalided from the R.A.M.C. In April, 1922, he again had renal colic, and a skiagram by Mr. Thurstan Holland showed two small calculi in the area of the right kidney. Since April, 1922, he had had frequent dull, aching pain in the right loin, without colic and without any pain in the groin or testicle. There was no increased frequency of micturition and there had been no visible hæmaturia.

When seen on February 28, 1923, I was unable to palpate either kidney, though pressure on the right side caused pain. The urine contained a trace of albumin and under the microscope a few white cells were seen. As the skiagrams by Mr. Thurstan Holland had been taken a year previously, I had a confirmatory skiagram taken by Dr. Finzi, who reported that the shadows in the right renal area were still present and further stated that the kidneys were normal in size, shape and position. There was fusion between the first and second lumbar vertebræ, which was thought to be probably due to old injury rather than to tuberculosis. It is interesting to note that the position of the shadows had changed relatively to the renal outline in the skiagrams taken at nearly a year's interval.

Operation was performed on March 6, 1923. After a right lumbar incision the kidney was exposed and the upper pole was easily separated, but the lower pole could not be drawn up. The incision was accordingly prolonged forward and the kidney further exposed, when it was found to be horse-shoe in form. There was a thick band of renal tissue about 1½ in. broad by 1 in. in thickness joining the lower poles, the right ureter passing in front of the connecting mass. The lower pole of the left kidney could be felt joining the mass, but the left ureter was not seen. I was unable to bring up the posterior surface of the right kidney enough to expose the pelvis and in the absence of any pyelogram I was uncertain of the anatomical arrangement, though I felt that had this been known, it would not have been difficult to remove the connecting band of tissue. The calculi were removed by nephro-lithotomy from the somewhat dilated calices and the renal incision closed by catgut sutures.

A further examination was made by Dr. Finzi in the light of this finding, but no evidence by radiography could be seen of the junction of the lower poles. I pressed the patient to allow me to carry out a pyelography, but to this he would not agree, though he has promised me that should he at any time have any return of pain, he will allow me to do so. I saw him again in October, 1923, and in July, 1925, when he was very well and entirely free from pain. He has accepted a post in Egypt so that there is some possibility that another calculus may form.

Case III.—Pelvic Hydronephrosis in a Horse-shoe Kidney.—Miss R., aged 31, was sent to me on January 25, 1926, complaining of pain in her left side. The pain began about two years before as an occasional aching, but during the last six months it had been practically continuous. The pain was felt in the left renal area, passing forwards into the left subcostal area with an occasional shoot into the groin. It had no relation to food or to exercise. There had been no increased frequency of micturition and never any visible blood in the urine, though the latter had been cloudy.

On examination she was found to be thin and her tongue was furred. Urine was alkaline and contained phosphates in excess. Specific gravity 1018. Albumin absent and cultures remained sterile. There was tenderness on pressure in the left renal angle on bimanual palpation, but neither kidney was palpable. The only other abnormal physical sign that could be detected consisted in rather coarse breath sounds at the apex of the right chest, suggesting some former tuberculous lesion. Skiagraphy by Dr. Knox showed no shadow of stone in the left kidney or ureter, and the left renal shadow was reported to be small. There were shadows of several old calcareous glands in the mesentery of the right side.

Cystoscopic examination in 12-ounce distension showed the bladder to be everywhere pale and normal. Both ureteric orifices were normal in position and in appearance. After an intravenous injection of 2 c.c. of a 0·4 per cent. solution of indigo-carmine there was a vigorous efflux of deeply-stained urine from the right orifice in five minutes, whilst the efflux from the left side was only slightly stained after ten minutes.

Pyelography.—A ureteric catheter was easily passed up the left ureter and the pelvis of the kidney injected with a 15 per cent. solution of sodium bromide. Ten c.c. were injected without discomfort and a negative taken, and later 27 c.c. were injected before any pain in the left side was produced. The pyelogram after the later distension showed considerable dilatation of the renal pelvis, the calices being rounded; there was a curious notch in each picture passing vertically from the lower margin of the pelvic shadow just internal to the uretero-pelvic junction. This suggested to my mind at the time a holding up of the dilated pelvis by an

aberrant renal vessel; but I now feel sure that it was really the dilated calyx passing downwards and inwards into the connecting band of renal tissue joining the kidneys. At the time I looked upon the case as one of hydronephrosis of the left kidney and advised operation.

Operation, March 6, 1924.—An oblique lumbar incision was made and the kidney exposed behind the peritoneum. On separation, the upper pole was easily drawn up, but the lower pole was firmly held down, and, on further separation of the tissues, it was seen that a thick mass of renal tissue passed in front of the aorta, to form a horse-shoe kidney. The pelvis of the left side formed a flaccid sac lying well anteriorly to the usual position in the renal hilum, and from the lower aspect of the pelvis two large divisions passed separately into the lower pole and into the connecting band; the left ureter joined the anterior aspect of the flaccid pelvis and passed downwards in front of the median mass; it was not dilated. The renal vessels passed from the aorta behind the pelvis. The posterior surface of the left kidney was considerably larger than the anterior surface. I was unable to see or to feel the right ureter, and I did not consider it advisable to attempt the removal of the left side, and therefore closed the wound. The accompanying diagram (fig. 1) shows the points mentioned above.

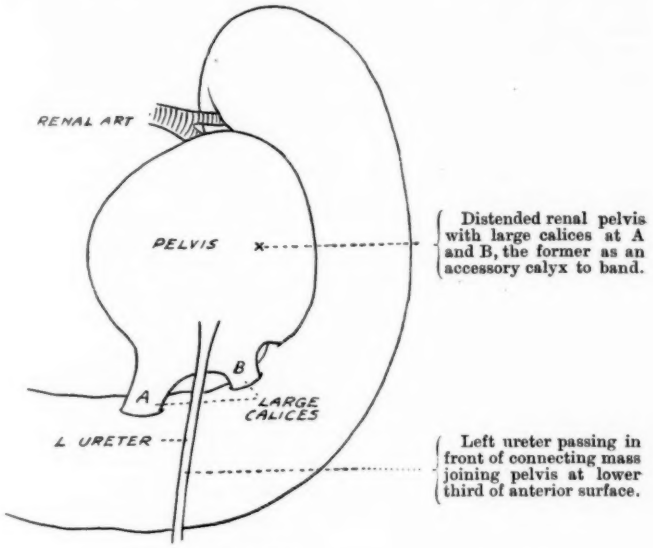

RENAL ART
PELVIS
Distended renal pelvis with large calices at A and B, the former as an accessory calyx to band.
B
A
LARGE CALICES
L URETER
Left ureter passing in front of connecting mass joining pelvis at lower third of anterior surface.

FIG. 1.—(Case III.)
Anterior surface of kidney was much smaller than the posterior and the distended pelvis was placed anteriorly.

On March 27, 1924, when the wound was healed, bilateral pyelography was performed Twenty-five c.c. were injected into the left side and 12 c.c. into the right before pain occurred. The appearance on the left side was almost exactly reproduced, but on the right side the pelvis was smaller. There was an even larger calyx passing inwards towards the connecting mass, showing a division into two smaller calices. The position of the right ureteric catheter made it obvious as to why the right ureter was not felt at the time of operation.

I have reported the various examinations of this case somewhat fully, but I think that I ought to have arrived at the correct diagnosis of horse-shoe kidney after the first pyelogram was taken. A year previously, on February 10, 1923, Mr. Clifford Morson reported a case of horse-shoe kidney in which a pyelogram showed an accessory calyx passing towards the vertebral column, and this should certainly have suggested the

condition in my case. The subsequent bilateral pyelogram in my case showed a similar accessory calyx on the other side, which was not present in Mr. Morson's case, but it should be borne in mind that an accessory inner calyx may be a point in diagnosis of this condition.

Case IV.—Multiple Cystic Disease in the Connecting-band of a Horse-shoe Kidney.—Miss H. S., aged 41, was sent to me by Dr. Harry Cooper, on February 19, 1924. She had been operated upon for the removal of the appendix eighteen months previously. She stated that for some months before her operation she had had aching pain in the right loin, but that it was better whilst she was resting after her operation. It returned some two months later, and ever since she has suffered from attacks of acute pain in the right side, passing down to the groin and leg. These attacks came on suddenly, varying from one to three in a week, lasting severely for from half to one hour. She had no desire to micturate during the attack, but with the cessation of pain, she might pass urine three times in the first hour. She thought that the attacks might be brought on by exertion, games, &c. On two occasions during the preceding summer she noticed that after swimming the urine was tinged with blood. She had recently been seen by Dr. John Fawcett, who made a diagnosis of hydronephrosis. On examination she was found to be thin, but she had not lost weight. The tongue was clean and skin acted. No thirst. The abdominal wall was resistant, but to the right of the umbilicus a rounded, nodular mass with convexity downwards could be felt; it moved with

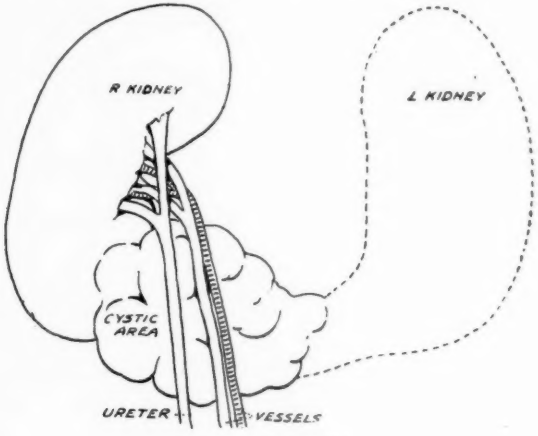


FIG. 2.—(Case IV.)

forced respiration and could be pushed forwards by a hand in the renal angle, but not so freely as the usual renal swelling. The left kidney and the liver were not felt. The urine was acid, specific gravity 1022; it contained 2·2 per cent. urea. No albumin was present. No sugar.

An X-ray taken by Dr. Knox showed no shadow of calculus in the urinary tract. Cystoscopy after intravenous injection of 2 c.c. of 0·4 per cent. solution of indigo-carmine. Bladder normal. Right ureteric orifice small and rounded. Efflux very variable; stained blue in six minutes; sometimes a slow puff into bladder, at others forcible blue jet. Left orifice normal; forcible blue efflux in five minutes. Segregation by ureteric catheter—right catheter passed whole length of ureter, but left catheter only passed for 10 cm. Both specimens clear and of good colour. Urea: right side, 1·4 per cent., left, 1·3 per cent. Cultures sterile. Pyelogram of right side: first picture after injection of 10 c.c. of sodium bromide showed some rounded shadows in renal area. Injection continued up to 18 c.c. before pain was caused, when several rounded shadows were seen, apparently connected with each other in the lower pole of the kidney and with the renal pelvis, which was apparently small. Patient was very

emphatic in her statement that the pain caused by this distension was exactly similar to the pain of the attacks.

I looked upon the condition as one of multiple cystic disease of the kidney, but not the polycystic congenital variety, and advised operation for nephrectomy owing to the disability caused by the pain. The blood-urea amounted to 33 mgm. per 100 c.c.

May 8, 1924. *Operation.*—An oblique incision was made in the right loin, and the muscles were divided. The perirenal capsule was opened and the kidney quickly exposed. The upper pole and the convex border were easily separated, but the lower pole would not come up easily, and on prolonging the incision and on further separation, it was seen that the ureter passed down in front of a nodular, rounded mass, which appeared to be continuous with the lower pole of the kidney. The ureter was traced upwards and found to enter the anterior portion of the renal hilum in two distinct branches without any true renal pelvis being apparent. On the inner side of the ureter and also crossing in front of the cystic mass was a leash of vessels containing a large artery and vein coming from below and entering the renal hilum behind the ureter. I was not able to trace these from their origin from the aorta, or, as is more probable, from the iliac vessels. On further examination the kidney was found to be a horse-shoe, a broad mass composed of multiple rounded cystic spaces as large as marbles embedded in renal tissue, joining the two parts together (see fig. 2). There was no apparent line of separation between the two renal elements and the cystic area extended across the middle line. The peritoneum was then opened in the anterior part of the incision and the hand introduced; this showed that the cystic mass joined the other kidney in a complete horse-shoe, but the actual left kidney felt of normal size and consistence. This cystic mass was evidently the mass palpated through the abdominal wall in clinical examination. I did not feel justified in attempting any separation of the mass from the kidney and so closed the wound. The patient did very well, and when heard of last in June, 1925, she was very well, though still troubled with aching pain in the right loin after exertion. There had been no further hæmaturia.

In looking back on these cases it seems to me that a correct diagnosis should have been arrived at in the one that showed the accessory internal calyx at the pyelographic examination, though the bilateral picture was only taken when the exact condition had been found at operation. The cystic condition of the last case in the pyelogram obscured any internal calyx. Perhaps I shall be more criticized for not attempting any separation of the connecting mass between the two kidneys, but in the first two cases this was hardly indicated—operation in the one was for traumatic rupture and in the other for calculi, which were removed. In the other two the pathological condition revealed at the operation and the gross alteration of the anatomical conditions present did not seem to me at the time to permit of this separation being done.

Section of Urology.

President—Mr. R. H. Jocelyn Swan, O.B.E., M.S.

The Musculature of the Bladder.

By E. D'Arcy McCrea, M.D.

(*Department of Physiology, Manchester University.*)

At the beginning of an investigation into the nervous control of the bladder, I found, on looking up the literature, that the textbooks of anatomy gave but little information, and, moreover, that the various investigators differed in their descriptions of the sphincters of the bladder. I availed myself of an opportunity which arose of dissecting and of preparing serial sections of a number of infants' bladders, and also of examining those of several adults; and I thought the results might be of interest to the Section.

The works of Henle, Kalischer, Griffiths, Versari, Wood Jones, and more recently that of Wesson, contain numerous important observations, and I think that it is necessary that their findings should be reviewed and re-stated rather than remain buried.

Some slides prepared from photographs and diagrams of my specimens will, I hope, serve to explain the details of the following review.

The body of the bladder shows two muscular coats, the one, incomplete and external—the longitudinal coat, the other complete and internal—the circular coat. Muscle fibres, however, pass from one to the other, and it is known that during distension the fibres undergo some rearrangement in position. A third coat, consisting of sparse and irregular longitudinal fibres, lying immediately below the mucous membrane, may also be described.

The longitudinal coat consists of somewhat coarse bundles of fibres, arranged for the most part longitudinally, and most complete along the sagittal plane of the anterior and posterior surfaces of the organ. At the apex and margins of the bladder many of the fibres from one surface become continuous with those of the other, but others are arranged in whorls so that the fibres continue on the same surface, passing up one border and down the other. Both on the anterior and posterior surfaces the longitudinal fibres, as they approach the vesical orifice, are collected into two comparatively narrow bands, and the posterior of these lies between the ureters. The circular coat therefore appears on the surface in the neighbourhood of the ureters, since here a triangular hiatus of the external coat exists; the apex of this area lies above, the base below (fig. 1).

The circular coat is composed of coarse, muscular bundles, on the whole circularly arranged; it is complete, and of considerable thickness, except in the region of the trigone. About the point of entry of the ureter the circular fibres diverge, and a Y-shaped structure results, the stem of the Y lying inferiorly, and the ureter entering between the limbs of the Y. As the base of the bladder is approached the bundles passing anteriorly from the stem of the Y on either side are especially well marked and compact (figs. 1 and 2).

The trigonal region shows a special musculature, which is entirely derived from the coats of the ureters. From each ureter strands of muscle descend downwards and inwards, and these interlace with one another to form a complete sheet of

muscle, triangular in shape, which covers the trigone and passes down into the internal urinary meatus. This muscle lies immediately below the mucous membrane, to which it is closely adherent, and inferiorly it becomes continuous with the posterior longitudinal fibres of the urethra; its margins form Bell's muscles, and its base the interureteric or Mercier's bar. The circular coat in the trigonal region is much diminished in thickness, and its bundles are smaller (fig. 3).

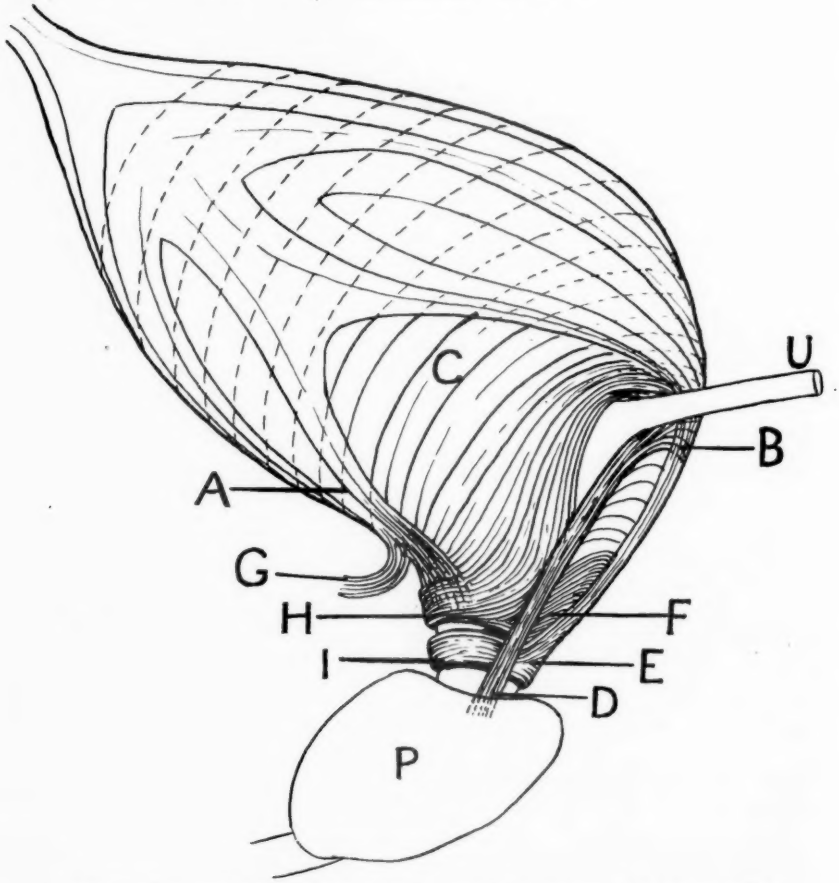


FIG. 1.—Diagrammatic representation of the course and arrangement of the muscular fibres of the bladder (lateral aspect). *A*, anterior longitudinal muscle. *B*, posterior longitudinal muscle. *C*, circular muscle. *D*, stem of Y-shaped tendinous band. *E*, external vesical sphincter. *F*, internal vesical sphincter. *G*, musculus pubo-vesicalis. *H*, crescent-shaped band of the circular muscle. *I*, sphincteric band composed of the internal and external vesical sphincters. *P* indicates the prostate, and *U* the ureter.

The irregular, internal longitudinal coat is better marked at the neck, and anteriorly and laterally it may be distinguished as descending to join the longitudinal coat of the urethra, which lies immediately subjacent to the mucous membrane.

The neck of the bladder shows an interesting arrangement of the musculature, but before proceeding to describe it attention must be drawn to a band which

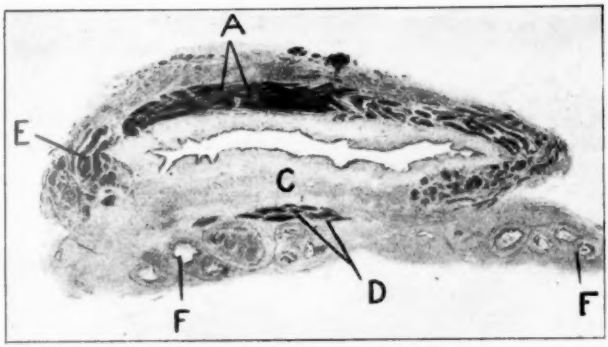


FIG. 2.—Photomicrograph of a transverse section through the trigonal region of an infant's bladder. (The section is somewhat oblique, the left side lying at a lower level than the right.) *A*, bundles of circular fibres forming anteriorly a crescent-shaped muscle between tendinous bands, and deficient posteriorly. *C*, trigone. *D*, posterior longitudinal muscle. *E*, stem of Y-shaped tendinous band. *F*,*F*¹, seminal vesicles.

embraces the proximal urethra just distal to the internal urinary meatus. This is a very distinct ring in the infant, and is identical in both male and female. It is composed of both striated and unstriated muscle fibres, and is derived from certain of the bladder and urethral muscles, which will later be described in detail (fig. 4).

The further distribution of the trigonal muscle must be referred to; this muscle

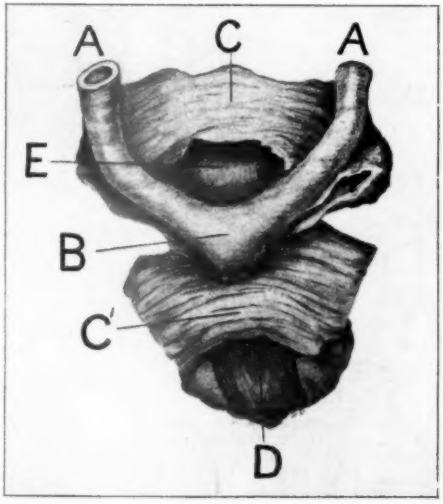


FIG. 3.

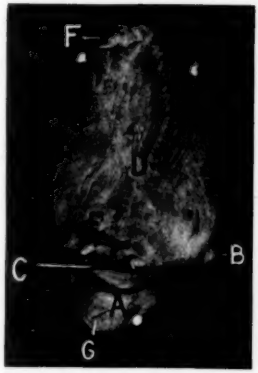


FIG. 4.

FIG. 3.—Drawing of the trigonal muscle, from a dissection made from the posterior aspect. *A*, ureter. *B*, trigonal muscle. *C*, circular muscle. *C*¹, circular muscle (reflected downwards). *D*, posterior longitudinal muscle (reflected downwards). *E*, cavity of bladder.

FIG. 4.—Photograph of the bladder of a male infant (anterior aspect). *A*, prostate. *B*, ureter. *C*, sphincteric band composed of the internal and external vesical sphincters. *D*, anterior longitudinal muscle. *E*, musculus pubo-vesicalis. *F*, superior ligament of bladder. *G*, urethra.

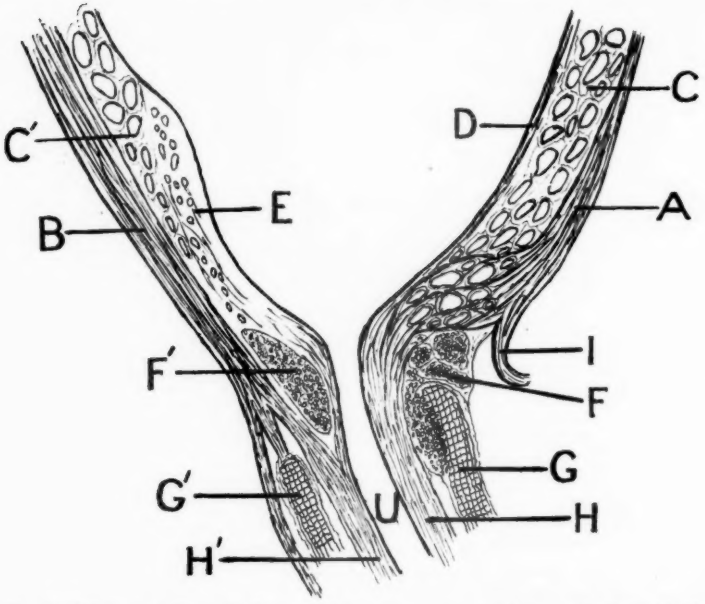


FIG. 5.—Diagram to illustrate the muscular arrangement about the neck of the bladder, made from a median sagittal section of the female organ. *A*, anterior longitudinal muscle. *B*, posterior longitudinal muscle. *C*, *C*^{1}, circular muscle. *D*, internal longitudinal muscle. *E*, trigone. *F*, *F*^{1}, internal vesical sphincter. *G*, *G*^{1}, striated circular coat of urethra which superiorly forms part of the external vesical sphincter. *H*, *H*^{1}, submucosal longitudinal muscle of urethra. *I*, musculus pubo-vesicalis. *U*, indicates the urethra. The terminations of the longitudinal coat of the bladder are well shown.

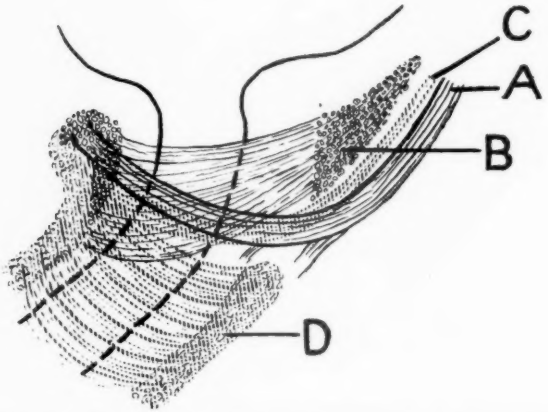


FIG. 6.—Diagram illustrating (in median sagittal section) the arrangement of the sphincteric fibres at the neck of the female bladder. *A*, posterior longitudinal muscle passing to the external vesical sphincter. *B*, internal vesical sphincter. *C*, striated fibres of trigone. *D*, striated fibres of urethra.

overlies the uvula vesicæ and its fibres may be traced along the crista urethralis and sometimes into the membranous urethra.

As we have seen, the longitudinal coat is collected into two bands, the one anterior, the other posterior. The posterior bundle, which passes between the ureters, forms a very definite tract which turns forwards into the vesico-prostatic groove and there divides into two parts, which encircle the urethra; these fibres lie, immediately proximal to, and blend with, striated muscle fibres to form the external vesical sphincter of Henle.[1] Other fibres from the superficial aspect of the posterior

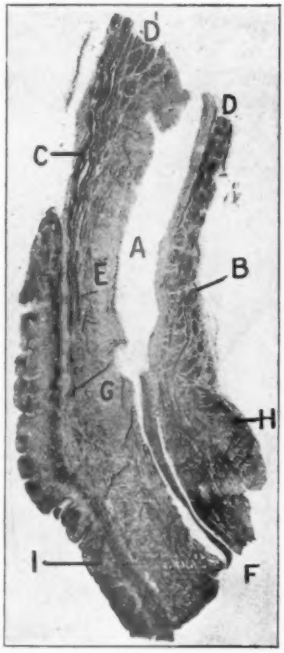


FIG. 7

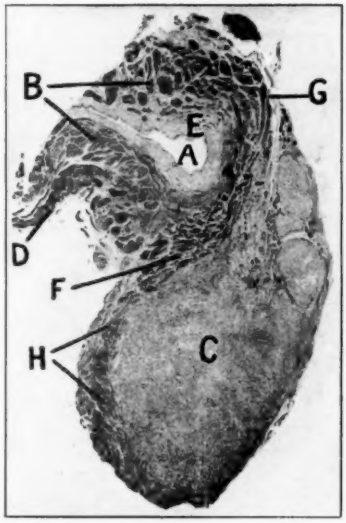


FIG. 8

FIG. 7.—Photomicrograph of a median sagittal section through the bladder of a female infant. The anterior longitudinal fibres passing down to join the submucosal layer of the urethra are well seen, as is also the mass of the external vesical sphincter. *A*, bladder cavity. *B*, anterior longitudinal muscle. *C*, posterior longitudinal muscle. *D*,*D*¹, circular muscle. *E*, trigone. *F*, urethra. *G*, internal vesical sphincter. *H*, external vesical sphincter. *I*, vaginal mucosa.

FIG. 8.—Photomicrograph of a sagittal section through the prostate and lower half of the bladder. The plane of the section lies lateral to that of the urethra and shows the fibres of the internal vesical sphincter passing downwards and forwards from the trigone to encircle the urethra. *A*, bladder cavity. *B*, circular muscle. C, posterior longitudinal muscle. *D*, anterior longitudinal muscle. *E*, trigone. *F*, internal vesical sphincter. *G*, prostate. *H*, striated muscle anterior to prostate.

bundle pass down the posterior and superficial aspect of the urethra in the female, and in the male become lost in the prostate; whilst yet others from the deep surface of the bundle pass vertically downwards within the ring of the external sphincter to join the submucosal layer of the urethra. In addition to these three methods of termination some fibres in the male enter and terminate amongst circular fibres of the neck of the bladder (figs. 5, 7 and 11).

[1] This term, the external vesical sphincter, does not refer to the sphincter urethræ membranaceæ first described by Guthrie.

The fibres of the anterior longitudinal muscle terminate in several ways: the greater number of the medial and deeper fibres enter between the bundles of the circular coat immediately above the orifice of the bladder, and the majority end here; a number, however, pass through and are continued downwards to join the submucosal layer of the urethra, while a few appear to turn laterally and run with the circular fibres. The more superficial and lateral fibres sweep laterally away from the neck of the bladder and form the musculi pubo-vesicales, which, in company

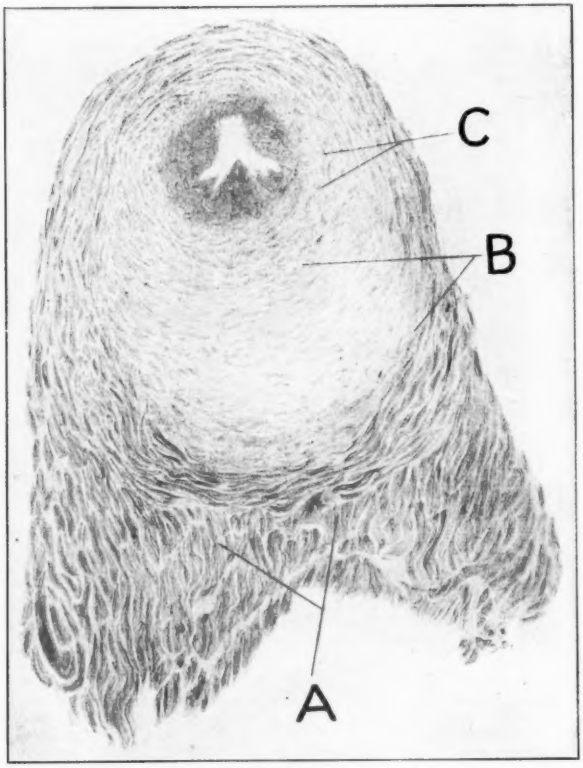


FIG. 9.—Drawing made from a transverse section through the internal vesical sphincter. The plane of the section passes from behind downwards and forwards. The arrangement of the fibres of the internal vesical sphincter is seen. *A*, posterior longitudinal fibres. *B*, internal vesical sphincter. *C*, internal longitudinal muscle of urethra.

with the pubo-prostatic ligaments, are attached to the posterior aspect of the pubes (figs. 5 and 7).

The circular muscle coat forms about the neck of the bladder a fibro-muscular ring, best marked anteriorly and laterally; in the latter position lies the stem of the Y, which descends from about the ureter, and into this band, which contains a number of tendinous fibres, are inserted many circular fibres, a feathered arrangement thus resulting (figs. 1 and 2). Anteriorly, the major portion of the external longitudinal coat enters and terminates among the circular fibres, and a fibro-muscular

mass is formed which appears to be anchored by the musculi pubo-vesicales. Lateral expansions are given off from this ring; they sweep downwards and pass along the superficial and lateral aspects of the urethra; these fibres are best seen in the female and form a definite band, but in the male the prostate interferes with their continuity. The fibro-muscular mass formed by the circular and anterior longitudinal coats contains a considerable number of muscle bundles, which are very well seen anteriorly and laterally, but are deficient posteriorly (figs. 1 and 2).¶

Immediately below this incomplete ring the internal urinary meatus is surrounded

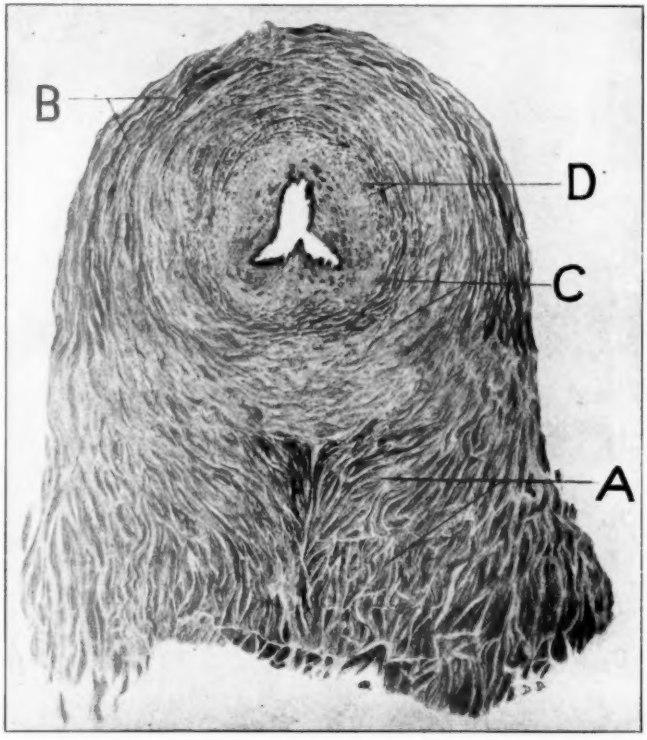


FIG. 10.—Drawing made from a transverse section through the external vesical sphincter. The plane of the section passes from behind downwards and forwards. The division of the posterior longitudinal fibres to encircle the urethra is well seen. *A*, posterior longitudinal fibres. *B*, striated muscle fibres. *C*, internal vesical sphincter (inferior portion). *D*, internal longitudinal muscle of urethra.

by a sphincter composed of closely knit fibres which differ considerably in appearance from those of the circular coat, and it is improbable that this is a continuation of the circular coat of the bladder. This sphincter lies below the level of the point of entry of the anterior longitudinal fibres and is especially well marked posteriorly, where it extends for a short distance up into the trigonal region; its fibres, especially the lower ones, extend downwards as well as forwards, and the lowest lie deep to the external vesical sphincter. The muscle, viewed from the lateral aspect, therefore

appears fan-shaped. This is the internal vesical sphincter of Henle, or sphincter trigonalis of Kalischer, which, together with the external sphincter, forms the band to which attention has already been drawn (figs. 5, 6, 8, 9 and 11).

In the region of the neck of the bladder there are therefore two systems of encircling fibres; a proximal and internal composed of closely-knit bundles of unstriated muscle, the internal vesical sphincter and a distal and external formed by the posterior longitudinal muscle together with a striated sphincter. The former

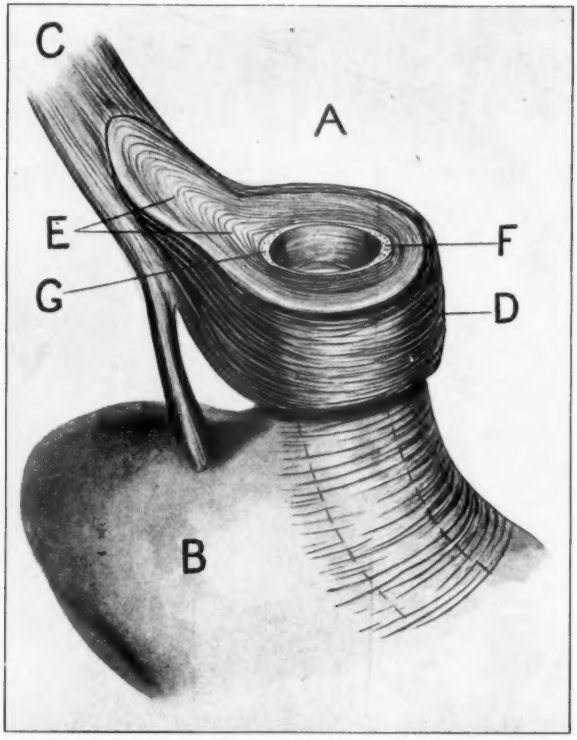


FIG. 11.—Semi-diagrammatic drawing of the musculature of the internal urinary meatus and proximal urethra of a male infant. *A*, bladder cavity. *B*, prostate. *C*, posterior longitudinal muscle. *D*, striated portion of external vesical sphincter. *E*, internal vesical sphincter. *F*, internal longitudinal muscle joining the submucosal layer of the urethra. *G*, trigonal muscle becoming continuous with the submucosal layer of the urethra.

embraces the internal urinary meatus and upper portion of the proximal urethra, and lies below and under cover of the crescent-shaped fibro-muscular mass formed by the circular coat together with the anterior longitudinal fibres. The distal ring, or external vesical sphincter, encircles the proximal urethra and contains both striated and unstriated muscle; the striated fibres are an upward continuation of the urethral muscle. Both these rings form together one band, which lies above the prostate (figs. 9, 10 and 11).

A noteworthy point, of which I have found no previous record, is the presence of striated muscle fibres in the trigonal region. Their course is very similar to that of the fibres of the internal sphincter; they pass downwards and forwards on each side from the trigonal region and lie between the posterior longitudinal fibres and the internal sphincter; they ultimately join the external sphincter. They extend an appreciable distance above the vesical orifice and their general form is that of a horseshoe. Their presence may help to explain the voluntary movement of the trigone, which Young has noted, and which may be observed during a cystoscopic examination if the patient be directed alternately to "pass water" and "hold water."

The whole picture of these muscles suggests that the trigonal region belongs to the urethra and has become incorporated in the bladder; this view is borne out by what we know in embryology. The sphincteric fibres found beneath the trigone, both striated and unstriated, therefore represent the distorted posterior urethral wall, and the bladder muscles proper have no share in the sphincteric mechanism, except through the fibres of the posterior longitudinal bundle.

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Section of Urology.

President—Mr. R. H. Jocelyn Swan, O.B.E., M.S.

Pyelograms of a Ruptured Kidney.

Shown by T. E. Hammond, F.R.C.S.

C. G., aged 25. Admitted to the Royal Infirmary, Cardiff, on October 13, 1925, having been knocked down by a motor van six hours previously. Blood was present in small amount in the urine; some tenderness and rigidity in the right lumbar region. No shock; pulse 90.

October 14.—A swelling appeared in the right loin; no increase in the pulse-rate; the hæmaturia had ceased.

October 22.—Cystoscopy showed deep blue efflux of indigo-carmine from the left ureter, that from the right only slightly coloured. Pelography showed much extravasation of the iodide solution into the perirenal tissues.

November 29.—Swelling in the lumbar region much smaller. Cystoscopy showed efflux from right ureter more deeply stained. Pyelography showed the extravasation better defined and smaller.

January 14, 1926.—Right kidney just palpable. Cystoscopy showed efflux from right ureteric orifice as deeply stained as that from the left. Pyelography showed a well defined but irregular pelvis.

This case demonstrates the extensive lesion of a kidney, with extravasation into the perirenal tissues, that may be followed by good return of function and a well shaped pelvis.

Tuberculous Right Kidney. Hydronephrosis of the Left.

Shown by T. E. Hammond, F.R.C.S.

Patient, a girl, aged 17. In 1923 suffered from frequent and painful micturition, which lasted for one year. In 1924 pain developed in the right lumbar region. In 1925 admitted to Glan Ely Tuberculosis Hospital for a swelling of the right side of the abdomen, which was in the position of the kidney and was tense and cystic but free from tenderness. There were no pus, albumin or bacilli in the urine. *Cystoscopy* showed a bladder with some scarring but no active tuberculous lesion. Both ureteric orifices were drawn upwards to the postero-superior wall of the bladder and were close together; no efflux was seen from either. When indigo-carmine was given intravenously a blue efflux appeared only from the left within five minutes but only so long as the pressure in the bladder was not raised; distension above two ounces prevented its appearance. A catheter was passed up the left ureter and the urine collected. It contained 1 per cent. urea, no albumin, no pus, and no bacilli. The blood-urea was 25 mgm.

In May, 1925, the right kidney was removed. It was much enlarged and converted into a pyonephrosis; the renal tissue was completely destroyed, and there was no communication with the bladder. There was an uninterrupted recovery after the operation, and no symptoms suggestive of uræmia appeared.

In July, 1925, the bladder was filled with 12 per cent. sodium iodide. The

skiagram showed a dilatation of the left ureter, and the iodide solution had ascended to the pelvis of the left kidney, which was much dilated. After the operation the blood urea never rose above 30 mgm., and on discharge was 25 mgm. This case is of interest from the fact that it shows that the only kidney may be hydronephrotic and may still be able to carry on adequately the renal function, so long as there is no obstruction to the outflow.

Bladder and Prostatic Cavity Fourteen Years after Prostatectomy.

Shown by J. SWIFT JOLY, F.R.C.S.

THE specimen shows the bladder and prostatic cavity opened anteriorly. The bladder is normal. The prostatic urethra is an antero-posterior slit, which is surrounded by a thick mass of rather firm tissue, lying within the fascial sheath. On microscopic examination this tissue was shown to be prostatic adenomatous tissue. The internal meatus was slit-like, and lay at the most dependent part of the bladder.

This specimen was removed from the first patient on whom the late Sir Peter Freyer performed prostatectomy. In his earlier cases, Sir Peter removed the gland in three pieces, as he tried to preserve the urethra. In this case the operation specimen consisted of two lateral lobes and a well marked median lobe. The gland was not enucleated as a whole. This is probably the reason why there was a recurrence of the adenomatous tissue.

The clinical result was extremely good. The patient had no urinary trouble after his operation.

Specimen of Staphylococcal Infection of the Kidney.

Shown by J. SWIFT JOLY, F.R.C.S.

Clinical History.—Patient, a male, aged 43, in the West African Service, suffered from an attack of boils in August, 1925. He had about 150 altogether. During the third week he noticed pus in his urine. Had vague pains in the abdomen, which later became localized to the right loin. Temperature at this time about 102° F. at night and 99° F. in the morning.

September 19, 1925. Admitted to hospital, and abscess in right deltoid opened. *Staphylococcus aureus* isolated from urine and from pus from abscess. Blood cultures negative. Treated with vaccines, diuretics, and hexamine. Irregular swinging temperature the whole time. On three occasions exacerbation of temperature, and loin pain, with clear urine.

Examination.—December 23, 1925. Large flabby man. States that he lost 5 stone in weight during illness. Large indefinite, fixed, painful mass in right loin. Nothing else abnormal on physical examination. Urine contained a small amount of pus, with *Staphylococcus aureus.*

Cystoscopy.—Bladder normal. Right ureter injected slightly. No efflux seen. Left ureter normal, clear efflux. 5 c.c. of 0·4 per cent. indigo-carmine injected intravenously. Good blue on left side in four minutes. No blue and no efflux from right in fifteen minutes. X-ray negative to stone. Outline of right kidney + +.

Pyelogram.—No. 6 catheter passed easily to renal pelvis. No urine could be sucked out. 7 c.c. of 30 per cent. sodium bromide injected. Large abscess cavity found connected with middle calyx. Upper calyx enormously elongated.

Nephrectomy.—December 31, 1925. Kidney removed within its fatty capsule. Convalescence uneventful except for slight suppuration of wound.

Specimen.—Kidney enlarged, pale, waxy colour. Distinction between cortex and

medulla lost. Five large circumscribed areas over which the tissues had broken down, and which were infiltrated with pus, could be seen on section. Fatty capsule infiltrated with pus in places.

Specimen of Genital Tuberculosis.

Shown by F. McG. LOUGHNANE, F.R.C.S.

W. S., AGED 23, complained of a painful swelling in the left testicle for two months. A year ago the right testicle was removed for tuberculosis.

On Examination.—Chest, some fibrosis, no evidence of active tuberculosis. Left epididymis swollen and tender; vas not nodular; prostate large and hard, but not tender; left and right seminal vesicles enlarged, hard and tender.

Operation (under spinal anæsthesia).—Inguinal incision; testicle, vas, both seminal vesicles and prostate removed *en bloc*, extraperitoneally. Both ureters were thickened and adherent to the vesicles. There were abscesses in the testicle, vas, vesicles and prostate.

Patient subsequently died from tuberculous broncho-pneumonia.

Sacculus of Bladder.

Shown by S. G. MACDONALD, F.R.C.S.

THIS sacculus was removed from a male patient aged 58, for infection (due to the *Bacillus coli*) of two months' duration. There were 10 oz. of residual urine. The opening of the sacculus was on the left side of the bladder to the outer side of the left ureteric opening. The suprapubic wound healed in three weeks, the patient passing urine naturally, but he still has a residuum of 2 to 4 oz. The chief justification for operating on these sacculi is infection with the presence of residual urine. I have shown this specimen mainly to raise the question as to whether excision of a diverticulum does enable a patient to empty the bladder afterwards. If not the chief argument for operation would appear to fail.

Ureteric Calculi.

Shown by CYRIL NITCH, M.S.

H. E. B., MALE, aged 54. Two attacks of profuse hæmaturia in five months, otherwise no symptoms. Urine contained pus and blood.

Cystoscopy.—Cystitis and œdema of both ureteric orifices. Stereoscopic skiagrams, taken after passage of opaque ureteric catheters, showed two large rectangular stones in right ureter and one large oval stone in left ureter.

Blood-urea 35 mgm. per 100 c.c.

Urea concentration test = 1·05 per cent., 1·10 per cent. and 1·20 per cent. in the three hours; therefore kidneys badly damaged.

Right uretero-lithotomy by Kidd's incision in October, 1921, followed by a similar operation on left a month later. *Calculi:* composed of blood-stained oxalate of lime. Both wounds healed by first intention and patient made a rapid recovery. Another attack of hæmaturia three and a half years later. Skiagram showed large oval shadow 2½ by 1½ in. at lower end of right ureter.

Cystoscopy.—Right ureteric orifice œdematous; left normal.

Right uretero-lithotomy through right paramedian suprapubic incision. Wound healed by first intention. *Calculus* large and white, composed of pure calcium oxalate. Weight, dry = ¾ oz.

The paramedian route was selected for the second operation on the right ureter as it was thought that access by Kidd's method would be rendered difficult owing to adhesions.

Points of Interest.—No signs of post-operative uræmia in spite of defective kidneys; pigmented calculi at first operation, white calculus at third operation; rapid recovery, the patient being up and about fourteen days after each operation.

Multiple Renal Calculi in a Child.

Shown by R. H. JOCELYN SWAN, O.B.E., M.S. (President).

A. C., MALE, aged 2 years and 8 months. Seen April 21, 1925.

When aged one year the child passed a small white calculus after a good deal of straining. Subsequently he occasionally passed "gravel" in his urine until at age of 2 years he passed two more small, fawn-coloured calculi. A week ago he again had severe pain and retention of urine from impaction of a calculus in the urethra. This was pushed back into the bladder by a catheter and, after a second period of impaction, was passed. This calculus was white and rough, and chemical analysis showed it to be composed of calcium and triple phosphates. Since then he has been free from pain.

On Examination.—Bright, well nourished child. Seemed free from pain; no history suggesting renal descent. Neither kidney was palpable; no suprapubic tenderness.

FIG. 1

Urine.—Alkaline. Albumin present in an appreciable quantity. There was a deposit of tenacious muco-pus with triple phosphate crystals. No blood.

Kidneys.—Skiagram showed numerous calculi in left renal area of varying size (figs. 1 and 2). There was a collection in the lower pole of the kidney, some larger

FIG. 2.—Radiograph of kidney containing calculi after nephrectomy.

ones in the upper pole and a group of smaller rounded calculi in the situation of the renal pelvis. No shadows seen in right renal area nor in the pelvis.

Cystoscopy.—Bladder slightly congested. Left orifice very large and patent with surrounding area of plum-coloured congestion. A few pieces of floccular muco-pus seen to be slowly extruded. Right orifice normal. Large efflux of clear urine.

Chromo-cystoscopy.—After indigo-carmine intravenous injection: good coloration from right orifice in eight minutes. No colour from left in twenty minutes.

Patient advised to undergo nephrectomy owing to the large number of calculi and destruction of the kidney by sepsis.

Operation.—May 29, 1925. Renal pelvis found to be dilated and packed with calculi. Ureter dilated with marked **S**-shaped kink one inch below pelvis of kidney.

Convalescence rapid and patient remains well to date.

Complete Caseation of Kidney.

Shown by R. H. JOCELYN SWAN, O.B.E., M.S. (President).

C. C. F., AGED 55. Had resided in Ceylon for twenty-five years. Malaria twenty years ago and gonorrhœa at age of 20. Had always had a certain amount of aching in the right loin, but does not remember any acute attacks of pain. Recently he saw Dr. Wyard for flatulence and epigastric discomfort and was sent for a barium meal examination, when, in a preliminary skiagraph, a very remarkable shadow was found present in the area of the right kidney, the latter appearing as a collection of rounded masses, suggesting the usual picture seen in a large renal hydronephrosis after full distension for pyelography. The line of the ureter could be traced in the skiagram (see fig).

Present Condition.—Patient pale and anæmic. Tongue slightly furred. Right kidney easily palpable, felt bossy on the surface and was tender to pressure. Left kidney not palpable. Urine alkaline, turbid with phosphates. Albumin absent. Testes and epididymes normal; no palpable nodules in prostate or vesicles. Right ureter not palpable per rectum.

Cystoscopy.—Bladder normal. Left ureteric orifice normal. Right orifice retracted and hidden in a deep furrow. No congestion around it.

Chromo-cystoscopy.—Blue coloration of urine from left side in forcible jets in seven minutes. No urine seen from right orifice.

Blood-urea 43 mgm. per 100 c.c. Leucocyte count showed 89 per cent. polymorphs, 9 per cent. lymphocytes.

Advised removal of right kidney as it was probably a source of toxic infection.

Operation.—Nephrectomy performed. Surface of kidney white in colour and

everywhere very adherent to perirenal tissues. Renal vessels small, but ureter much thickened and adherent to peritoneum. It was divided below the level of the iliac vessels, when some thick cheesy material escaped.

Pathological Report.—No evidence of tubercle found. Whole kidney disorganized into a caseous mass.

Congenital Hydronephrosis.

Shown by F. Fowler Ward, M.B.

J., male, aged 8. For four years has complained of abdominal pain, occasionally accompanied by vomiting. Attacks occurred at monthly intervals. No definite urinary symptoms except that he usually had to micturate once or twice nightly.

On Examination.—Some tenderness in right flank, and pressure gave him a pain similar to that of previous attacks.

Cystoscopy (under general anæsthetic).—Bladder normal; ureteric orifices normal.

Intravenous Indigo-carmine.—Flow of dye from left orifice in six minutes, none from right in twenty minutes. Ureteric catheter passed only 1 cm. into right orifice. Indefinite swelling in right kidney region.

Operation.—Lumbar incision ; a large soft kidney exposed, semi-fluctuating, ureter normal. Kidney removed. On incision, found to contain 4 oz. of clear urine in a highly dilated sac ; kidney cortex $\frac{1}{4}$ in. in thickness only. Ureter high up in kidney pelvis, the obstruction being of the pseudo-valve type. Uneventful recovery.

Diverticulum of Bladder.

Shown by F. Fowler Ward, M.B.

Male, aged 53, admitted for acute cystitis of recent origin.

On Examination.—Per rectum, an indefinite swelling in region of prostate, frequency of micturition, urine ammoniacal with blood and pus.

Cystoscopy (later).—The mouth of a diverticulum seen in middle line 1 in. above inter-ureteric space.

With the bladder distended the whole of the rectal space was filled, and the prostate could not be felt until most of the contents of bladder and diverticulum were evacuated.

Radiogram.—Ten per cent. sodium bromide, two centrally situated spherical shadows, one 1½ in. above the other, the lower being the diverticulum.

Operation.—Extraperitoneal. The diverticulum was separated from surrounding structures as far as the level of the ureteric orifice. The bladder was then opened by vertical incision continued as far as the opening of the diverticulum. The lower part of the diverticulum was then separated from the prostate, &c., and incision carried round the opening of the diverticulum. Bladder sewn up by interrupted catgut sutures. Convalescence delayed by *Bacillus coli* pyelitis, but bladder function good.

Multiple Papillomata of Renal Pelvis.

Shown by F. FOWLER WARD, M.B.

PATIENT, a girl aged 18. History of four attacks of profuse painless hæmaturia. On admission—no blood in urine, which contained no organisms, &c.

Cystoscopy.—Bladder normal, a small polypus seen, attached to edge of right ureteric orifice.

Indigo-carmine Test.—Left, in five minutes. Right, effluence of dye much delayed, and small in amount, catheter passed without difficulty as far as right kidney.

Diagnosis.—Polypus of right kidney with metastatic growth at right ureteric orifice.

Operation.—Nephrectomy by lumbar incision, the ureter being removed as far as the pelvic brim. The ureter was dilated to within 1 in. of its pelvic junction. On splitting the kidney the pelvis was found to be slightly dilated, and studded with about twenty small polypi, the size and shape of small rose thorns. Uneventful recovery.

Note.—(1) Since showing this specimen the lower half of the ureter and its orifice have been removed. Previous to removal a ureteric catheter was passed for guidance during operation. A crenated oval stone, 1 cm. by ½ cm., was found lying free in the lower end of the ureter, which was considerably dilated as far as the bladder wall. No other polypi were found either in ureter or in bladder.

(2) The girl never had any pain, and on two occasions a ureteric catheter was passed without evidence of obstruction.

Two Cases of Vesical Calculi following Cæsarean Section.

By H. P. WINSBURY WHITE, F.R.C.S.

Case I.—The first specimen from this case shows a series of four phosphatic stones ranging from a diameter of 1¼ to ¼ in., and three portions of suture material all passed *per urethram* by a female aged 38.

The patient was sent to me because she suffered from bladder symptoms, dysuria, frequency of micturition and terminal hæmaturia. She brought some of the stones and sutures with her.

Her story was that she had submitted to two Cæsarean sections at the respective periods of two years and five years previously, and that it was only during the past six months that she began to suffer with her bladder, passing the stones and sutures at varying intervals. On cystoscoping the patient I was able to make out that there were still three stones in the bladder. Two of these, the larger ones of the specimens shown, were passed subsequently to this examination. I propose to remove the

remaining stone by suprapubic lithotomy rather than by litholapaxy for reasons that will be given later.

Case II.—This is represented by the lantern slide of a radiogram showing a vesical stone, almond-shaped, and about 1¼ in. in its longest diameter. The patient, a woman, aged 32, was also sent to me because of dysuria and frequency of micturition. She gave a history similar to that of the first case. A Cæsarean section had been performed upon her seven years previously, and it was not until three months before I saw her that the bladder symptoms began to appear. On cystoscoping the patient I was able to see a vesical stone suspended from the apex of the bladder. If the history be taken into consideration the stone was almost certainly attached to the vesical wall by a thread upon which it had developed. As in the previous case, I decided to deal with this one by suprapubic lithotomy.

On opening the bladder I found the calculus lying on its floor with ¾ in. of thick linen thread projecting from one end. The thread with its stone had obviously become detached from the bladder since the cystoscopy. In addition to this the loop of another suture without any attached stone was seen projecting into the vesical cavity about halfway up the posterior wall; from this position the portion of thread was readily removed. On palpating the uterus through the opened bladder, the anterior surface could be felt to be intimately adherent, throughout its whole length, to the upper surface of the latter structure. No doubt the adhesion of the suture line of the uterus to the bladder is the first step in the transference of the unabsorbable suture material from the former to the latter organ.

Suprapubic lithotomy seems to be the operation of choice in dealing with these cases, so that the bladder-wall may be carefully inspected for any projecting sutures not visible through the cystoscope. On the other hand, litholapaxy seems specially contra-indicated while there is a danger of the stone being still fixed by a suture to the bladder-wall.

Case of Prostatic Calculi in a Patient aged 32.

By H. P. Winsbury White, F.R.C.S.

The lantern slide indicating the radiogram of the vesical region shows a considerable collection of prostatic calculi.

The patient complained of persistent and marked pyuria dating from an attack of gonorrhœal urethritis five years previously. The history showed that under regular treatment the urethral discharge and the gonococcus did not persist unduly, but that the pyuria resulting from the acute infection had persisted up to the present time. Five years after the gonococcal infection, when I examined the patient, his general health appeared good; he complained of some aching in the lower part of the back, and his urine was very turbid with pus. Rectal examination, judging by the firmness of the prostate and the thickening of the seminal vesicles, indicated some degree of vesiculitis and chronic prostatitis, but no prostatic stones could be felt, nor did the palpable changes in the prostate and vesicles seem sufficient to account for the condition of gross pyuria. A complete investigation of the urinary tract was therefore undertaken.

Cystoscopy, carried out in conjunction with renal functional tests, indicated that the kidneys were not the source of the pus, nor was there any visible intravesical cause.

Radiograms of the urinary tract at once indicated the site of the infection. I had hoped to be able to remove the prostate with the stones, so as to lessen the likelihood of recurrence, but this I found to be impossible as these had given rise to a large intraprostatic cavity containing them and leaving only a small

adherent portion of the surrounding gland. The stones were easily shelled out and convalescence was uneventful.

Prostatic calculi are more frequently met with in later life, commonly in connexion with urethral stricture and simple prostatic enlargement. The case is a reminder that the condition may occur much earlier, even in infancy, and may cause no symptoms until some complication sets in and calls attention to its presence.

[*May* 27, 1926.

The Function of the Testes after Puberty.

By T. E. HAMMOND, F.R.C.S.

(ABSTRACT.)

THE teaching in Britain has been that both testes should never be removed, as not only does this deprive a man of some of the pleasures of living but leads to mental failure and early decay. French surgeons hold different views, for Légueu advocates removal of the testes when amputating the penis, as "if left they serve as sad and silent witnesses of a function that has gone for ever."

Recently I had the opportunity of examining seven cases of castration, where both testes had been removed for tuberculosis, and was guided in my findings mainly by the clinical examination. Attention was paid to the following points:—

(1) The mental and physical power.
(2) Sexual desire and potency.
(3) Changes in the secondary sexual characters.

The investigation of sexual potency was difficult and the statements of the men were accepted.

It was not easy to prove whether there had been any changes in the secondary sexual characters. The masculine type would be exemplified by Adonis and the feminine by Venus, but variations are too frequently found. Many of the supposed differences between the sexes are probably due to fashion and training. The present mode among women of dressing hair—the Eton crop—makes evident the resemblance between the faces. The physique of the modern sporting girl differs much from that of the girl of twenty years ago and approaches that of the boy. The growth of hair over certain regions of the body is regarded as a sign of masculinity. When the ease with which a beard appears after fifty is contrasted with the difficulty with which a moustache is grown before twenty-five, it does seem as if the growth of hair on these parts may be as much a sign of senility as of virility.

One hundred pensioners who had been disabled by wounds were examined with a view to fixing a standard. They were found to differ as much in their genitalia and secondary sexual characters as in their faces. Consequently, when any apparent abnormality was detected in a castrate, the possibility of its being peculiar to the individual had to be excluded before it could be regarded as a sign of reversion.

Case I.—Aged 24. Seen twenty-one months after castration. Had never felt better in his life and could do his mental and physical work as well as ever. Nocturnal emissions were very frequent for some months; they still persisted once a week and were associated with erotic dreams. Formerly shaved each day, now five times a week. The hair of the body was sparse, but he was definite that this was the case before the operation.

Case II.—Aged 51. A deaf and dumb mute. Seen nine months after castration. The attendant from the institute stated that his general health had improved, and both mentally and physically he was more active.

Case III.—Aged 39. Seen three and a half years after castration. Sexual desire and

powers were increased immediately after the operation. Is still able to carry out coitus once a week and has an emission, but is doubtful if it brings the former relief. There is no change in the ability to do mental and physical work. Still has to shave each day.

Case IV.—Aged 30. Seen twenty-three months after castration. Somewhat pallid. No increase in weight. Mentally as active as ever; physically not so strong. Sexual desire was increased for some months after operation, but was now not quite so great as before. Still carried out coitus, but had no emission, though there was some relief. There was chronic tuberculosis of both lungs of eleven years' standing.

Case V.—Aged 32. Seen three years after castration. Sexual desire was increased immediately after the operation. Still able to carry out coitus and had a definite emission. Mentally he was as active as ever. At times he became hot and had night sweats. His general condition was good, but there was tuberculosis of the left kidney.

Case VI.—Aged 45. Clerk. Seen nine years after castration. Had been able to carry out coitus with a definite emission until one year previously. There was no impairment of his mental or physical powers. Had put on weight during the last few years.

Case VII.—Aged 30. Seen four years after castration. General condition good. Had put on weight. No impairment of mental or physical vigour. Soon after the operation there were frequent erections but no emissions. The hair on the body was of the eunuchoid type and he shaved once a fortnight. The penis was small and infantile. He had served in the Army during the War, when shaving once a fortnight was sufficient to prevent his being reprimanded, and, as he then disliked undressing in front of his comrades owing to their comments on his genitalia, there can be no question that his condition had preceded the operation. Erections were frequent after the operation, but there were no emissions. These had now disappeared and he prided himself on his having conquered all desire.

To none of these men had castration come unexpectedly and the shock of a sudden deformity did not come into play. When taken as a whole, apart from an empty scrotum and a possible want of tone they differed little from normal man. Most had put on weight and there was no deterioration in the mental qualities. There was no change in the voice. Sexual desire was somewhat less than is seen in men of the same age, though when present it was always associated with potency. The increased desire that immediately followed the operation was probably due to irritation of the central end of the spermatic nerve.

The removal of a vital endocrine gland the main function of which is known is soon followed by definite changes. The examination of these cases of castration shows that, while the internal secretion of the testis has some action in stimulating sexual desire and also metabolism, it has not that action upon the mental and physical well-being which is claimed by the advocates of rejuvenation. It is possible that ideas handed down from the past, which were based upon the romance and mystery which have always surrounded the sexual organs, still influence our views.

The Influence of Sex Worship.

Mystical powers were in the past attributed to the sexual organs, and the worship of the penis played a prominent part at the feasts of savages. Phallism was the main rite in the worship of Dionysus,—the religion of Ancient Greece. While Christianity has modified our views to some extent, the law of Moses emphasized the importance of keeping the genitalia intact, for it states, "He that is wounded in his stones or has his privy member cut off shall not enter into the congregation" (*Deut.* xxiii, 1).

The Stigma of the Eunuchs.

The Roman emperors had suffered from the treachery of their followers and appreciated the fidelity of the eunuchs, who were given important posts in the depart-

ments of the State. As the eunuchs were in power in the Empire during its decline, they have been denounced by historians. Gibbon says,

"The aversion and contempt which mankind has so uniformly entertained for that imperfect species appears to have degraded their character and to have rendered them almost as incapable as they were supposed to be of conceiving any generous sentiment or of performing any worthy action."

As the eunuchs often took a prominent part in politics, all that was expressed of them need not be regarded as true. They were men of low birth who, starting life as slaves, were promoted to the offices of the State only if they showed any special aptitude. Flattery and bribery were common practices, but should probably be assigned to their oriental extraction. Any failure of duty on their part was ascribed to the absence of testes. Gibbon seems definitely of the opinion that "testes make the man" and in this respect is a worthy forerunner of the rabid endocrinologist of to-day. Character, however, is not merely the product of an internal secretion, for it is far more affected by heredity and early training than by the mere presence of these glands. The desire for power and fame was as great in those times as in our own, and it will be found that rise of the eunuchs to power took place in times that were characterized by debauchery and licentiousness, to which the Roman citizens were then too freely addicted.

Some eunuchs lived exemplary lives. Hermias, who received the praises of Aristotle, and Narses, who took command of the Roman armies and defeated the Goths, may be cited as examples.

The Work of Brown-Séquard.

Brown-Séquard at the age of seventy-two injected himself with the extract of the testes of guinea-pigs and immediately experienced a return of mental and bodily vigour, which he attributed to the action of an internal secretion. As no difficulty is experienced in preparing the extracts, and as a hypodermic injection requires no skill, it is obvious that suggestion played a large part in his experience, since these results have not been obtained by others.

The Effect of Castration in Man.

Whenever any condition follows the removal of an endocrine gland, it is at once attributed to the loss of an internal secretion, often on very insufficient grounds. If 100 men were suddenly deprived of their right arm, one or two might become insane and some depressed. The mental state would be due to the shock of the operation or to the resulting deformity and loss of power. The possibility of such factors should not be ignored after castration.

That an empty scrotum has its vexations is shown by Guinard's case of an elephant hunter with undescended testes, who had ivory balls inserted rather than put up any longer with the indulgent remarks of his comrades. That a deformity may give rise to mental symptoms is claimed by Hermance, who, having a patient with only one testis, who was becoming demented from the fear of being childless, inserted one of silver and later delivered the wife of two children. Weir and others have claimed that the mental symptoms following castration are psychological and do not develop if celluloid balls are inserted at the operation.

The dread of loss of power must have some effect, for it is well known that the onset of impotence does at times lead to definite mental symptoms.

When castration was carried out for prostatic obstruction, mental changes sometimes supervened. These do not differ from those seen after prostatectomy and are probably the cerebral manifestations of uræmia.

The Relation of the Testes to Enlargement of the Prostate.

The increased or diminished sexual desire sometimes found can be explained on

physiological grounds. The enlargement first gives rise to congestion of the prostatic urethra and an increased desire that can be gratified by coitus. As the pressure on the ejaculatory ducts increases, the vesicles do not become completely emptied; either atony supervenes, leading to distension and complete loss of sexual desire and power, or infection with much sexual irritability. That it is an irritability, and not an increased desire, is shown by the erections being rarely associated with any emission and by the little relief which follows coitus. It is impossible to be certain whether improvement will follow prostatectomy, as the ejaculatory ducts may later become compressed in the scar tissue.

Rejuvenation.

Steinach considered that old age was due to lessened activity in the testes. He therefore ligatured the vas deferens and considered that a greater amount of the internal secretion was thereby formed. There is no evidence that the suppression of an external secretion ever does lead to an increase of the internal. In addition, Steinach ignores the lessened activity which is present in all organs in old age.

Voronoff noted the want of physical and mental vigour in the Egyptian eunuchs and came to the conclusion that old age was due to diminished activity in the testes. These eunuchs are Nubian boys who are subjected to a mutilating operation at the age of 9 and later become slaves in the eastern households, which is scarcely the ideal method of obtaining an "A1" population. Whenever a swelling persists after engrafting a piece of the testis, Voronoff immediately assumes that the graft has survived and is functioning. He ignores the fact that such a swelling may denote merely the reaction of the tissues to a foreign body.

When the results of testicular therapy are studied, it will be found that no matter how the treatment is applied, successes always follow. The affections treated are most varied in their pathology and causation, and are as numerous as those put forward by Coué as suitable for auto-suggestion. Such claims follow all new methods of treatment and are due to the failure to appreciate a fundamental principle, namely, that with all therapeutic measures there occur faith, hope, therapy, these three; but in the process of rejuvenation the greatest is not vasectomy.

Mr. Frank Kidd said he agreed with Mr. Hammond that in the majority of persons castrated after puberty there was no loss of mental and bodily vigour, and little, if any, loss in sexual appetite or power. Common sense was necessary in dealing with castrates, who should be given a cheerful prognosis and not be encouraged to brood over their condition. Nevertheless, he thought that Mr. Hammond made too light of the complex behaviour of the internal secretion of the testicle, which was, in fact, well illustrated by the last case Mr. Hammond had quoted. Recently he (Mr. Kidd) had met with a patient, aged 40, who at the age of 24 years had completely lost his right testicle, and at the age of 26 years his left testicle, through inflammatory disease. Though the voice of this patient was broken yet he spoke with a curious soft musical voice, was effeminate in his behaviour, had an infantile penis and complete atrophy of both testicles. He had excessive subcutaneous fat, very little hair on the body anywhere, a complete absence of the central line of hair below the umbilicus, and broad hips like a woman. But far more remarkable than that, he had lately developed quite large breasts on each side. These he was able to conceal for a time, but lately the right breast had grown to a considerable extent, far outstripping the left breast, so that he was anxious as to whether he could any longer conceal his deformity, even by the most expert tailoring, and he was considering the surgical removal of the offending organs. It was remarkable that the breast was growing larger on the side on which the testicle first began to atrophy.

This case showed that deprivation of the testicular hormone could be of importance even after it had finished moulding the features of puberty, and served to illustrate another difficulty, namely, the occasional unilateral action of a hormone, such as might be seen in unilateral exophthalmic goitre. The problem was therefore not one to be dismissed so lightly as Mr. Hammond rather implied.

Operation for Epispadias and Ectopia Vesicæ.

By A. RALPH THOMPSON, Ch.M.

(ABSTRACT.)

MR. A. RALPH THOMPSON demonstrated three cases in whom the operation of splitting and transplanting the lower portion of the divided right "rectus abdominis" muscle, around the passage leading from the bladder, in the state commonly known as epispadias, or allied conditions, had been performed. The patients in these cases had complete incontinence, and were commonly very wet day and night.

The first case, that of a girl aged 8, was operated upon in January, 1923. She is now able to go to school. She holds her water for two or three hours during the day, and is never found to be wet when visited at irregular, but frequent intervals, by the district nurse. She wets her bed, however, at night.

The second case, that of a girl aged 10, was operated upon in July, 1924. She holds her water very well during the day, at the present time, and can hold it for three hours, but she wets her bed at night. She is looking forward to going to school quite shortly now.

The third case, that of a boy aged 4, was also shown. He can hold his water during the night and the bed in which he sleeps is not wet, but during the day he does not, at present, hold his water for more than ten minutes, as a rule, although he has held it for as long as half an hour. In this case the transplanted rectus can be seen to be acting, and for this reason, and also because the boy is very young, it is hoped that education may improve his condition during the day very greatly.

A fourth case—that of a girl aged 10, who is very nervous, and, perhaps, mentally deficient,—was not shown, but is a failure, and it is anticipated that the ureters may be transplanted into the bowel.

Mr. A. RALPH THOMPSON, in reply to remarks made in discussion, said that, in his opinion, the groove on the dorsum of the penis in cases of "ectopia vesicæ" and "epispadias" was not a urethra, even partially formed. It was simply the groove which would be formed between the prominences of the "corpora cavernosa," one on each side of the middle line.

He also drew attention to the loose terminology which was sometimes employed by authors and surgeons in connexion with congenital deformities of the lower urinary tract. In many cases it appeared that the term "trigone" was used when the whole extroverted bladder was really meant.

The extroverted bladder was actually larger in the new-born child than at any future time after the child had commenced to walk, owing, in the latter case, to the action of the two recti muscles tending to reduce the hernia of the intestines which lay behind the extroverted bladder before the erect attitude was adopted, and tending to keep up the development of the muscle of the extroverted bladder during this period. When the hernia was reduced by the action of these muscles, then, and then only, did the bladder muscle become atrophied, and the bladder become smaller; but even so, it represented the whole bladder and was not only the "trigone."

Case of Ectopia Vesicæ.

By A. CLIFFORD MORSON, O.B.E., F.R.C.S.

MALE, aged 3, admitted to the Islington Infirmary, December, 1925, with complete ectopia vesicæ and severe excoriation of the skin of the scrotum and inside of each thigh.

January 6, 1926, modification of Maydl's operation performed, consisting of

transplantation of the trigone of the bladder, together with the ureteric orifices, into the pelvic colon. The technique adopted was as follows:—

A catheter was inserted into each ureter and the bladder separated completely from the abdominal wall. Whole of bladder then excised except trigone. The trigone mobilized, together with about 1 in. of each ureter. This part of the operation was tedious and difficult, for it had to be borne in mind that interference with the blood-supply of the lower end of the ureters would render the operation a failure.

A loop of the pelvic colon was then brought out through an opening in the peritoneal cavity. The mucous membrane of the trigone was stitched to the mucous membrane of the bowel through a longitudinal slit in the latter. The posterior surface of the trigone was covered with the peritoneal coat of the bowel.

The patient made an uneventful recovery from the operation. He has grown, put on weight, and runs about the ward like any other child of his age. Control of the anal sphincter is perfect and urine is voided every two hours. The temperature has remained normal since the operation.

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War Section.

President—Lieut.-General Sir WILLIAM LEISHMAN, K.C.B., K.C.M.G., F.R.S., A.M.S.

Research in the Medical Services.

By Sir WILLIAM LEISHMAN, K.C.B., K.C.M.G., F.R.S., A.M.S.

MAY I, in the first place, express to the Section my sincere thanks for the honour they have done me in appointing me to be their President for the ensuing Session? I feel this to be a very high compliment, and I can assure my fellow Members that I will do all that in me lies to secure their interests and to maintain the work of the Section at the high level which it has reached under the wise guidance of my distinguished predecessors in the Chair, and their energetic secretaries.

Considering our youth I think we have reason to congratulate ourselves on the evidences of vitality demonstrated at the meetings. The wide range of subjects which have been brought forward, and the valuable discussions to which they have often given rise, show that there is abundant justification for our existence, and that there is a general feeling among the Services that its meetings are of value to them.

The attendances at the sectional meetings in the past may, I think, be regarded as fairly satisfactory, especially when we consider how few serving officers are stationed in or near London; but, though I trust we may see some improvement in this direction, it will, I fancy, always be the case that a Section constituted as we are must rely on reaching the main body of the Members through the printed *Proceedings*. It is in my mind to discuss with the Council of the Section whether, recognizing this point, we may not organize some machinery which would have the effect of bringing before the meetings a larger volume of comment and experience in connexion with the subject of discussion from those whose views we should value but who, for various reasons, are unable to be present in person.

Another point I should like to mention before turning to the subject of my address. Representing as we do the medical services of the fighting forces of the Crown we have naturally brought forward at our meetings papers which, from their title, might give the impression that they would be of interest only to the particular Service to which the writer belonged. This may, and probably does, do something to limit the attendance of Members, who may regard it as unlikely that they would learn anything of interest or value to themselves. This I believe to be a mistaken view; at any rate, to judge from my own experience, I have listened with pleasure and derived great benefit from papers and discussions on subjects from which I was, perhaps, anticipating neither the one or the other. Modern warfare, like medical science itself, becomes increasingly complex and many-sided, and we cannot tell from month to month what new branch of knowledge we may have to familiarize ourselves with, or in what new direction some subject, hitherto regarded as "the other man's job," may become of direct importance to ourselves. Yet again, I am one of those who consider that we often get most valuable and suggestive criticism from those whose lines of work are altogether different from our own but from whom some aspect of our subject or problem calls forth a question or a comment from an unexpected angle. May I hope, then, that we may have yet fuller discussions of our papers and that the members of the sister Services will not hesitate to join in even if the subject matter under discussion be confined apparently to one of those Services? I hope it is quite unnecessary for me to add that we look on all the Members of the various Reserve Forces, as well as our comrades of the late war, as part of ourselves.

The subject of the introductory address, which it is customary for the new President to deliver, has exercised me considerably. I was soon forced to recognize that it was not in my power to prepare, in the time at my disposal, a paper upon some specific subject which might lie within my competence and which might be worthy of the occasion. I have, perforce, had to choose one of a general nature, and, not unnaturally perhaps, have selected that in which I have had a deep interest for a large part of my career in the Service—research.

At the outset it is my purpose, if I can, to remove from your minds the impression that research is of necessity an esoteric matter, confined to mysterious laboratories, and that it can be carried out only by professors and specialists who have given years of work to their subject, who are a "peculiar folk" and talk in a tongue "not understanded of the people." It is true that much experimental inquiry demands expert knowledge and special equipment and comes within the opportunity of comparatively few of us, but I prefer to give to the word "research" a much wider significance and to take it to cover any means by which we, of set purpose and on a deliberate plan, strive to add to the existing knowledge of the cause, the prevention and the treatment of disease. I have on more than one occasion spoken on this subject and have urged in connexion with it a far closer collaboration for this purpose between clinician and specialist than exists at present.

Let us examine in some detail our position as medical officers of the fighting Services *vis-à-vis* this question of research.

It is not my intention to dwell on the admirable research work which is in continual progress in our respective colleges and laboratories, nor to point out the moral of the incalculable benefits which the Services have enjoyed as a result of much of that work. This would leave no time to deal with anything else, and I prefer to speak of the present, and still more of the future, rather than of the past.

I am bound to admit that the present moment does not appear to be an ideal one for suggesting that, with our diminished personnel, overworked officers should voluntarily add to their heavy work; but, after all, we are only passing through a period of depression, and such periods, familiar enough to those of us with long service, lapse, and have usually been followed by conditions better than those that preceded the negative phase.

Be that as it may, I know I am not exceptional in holding as a firm belief that there is a profound difference between work which, however conscientious and good, is more or less of a routine, and that which is varied and which brings with it continual new interests. Anything in the nature of research, understood in the broad sense I mentioned just now, belongs definitely to the latter category and has the further great attraction that it brings us into that closer intellectual sympathy with our colleagues which is one of the results of the pursuit of a common purpose.

Let us now look for a moment at the very exceptional facilities and opportunities which we of the Services possess; they are indubitable and, I believe, far greater than those enjoyed by the great majority of our confrères in civil life. First, and most important, our material. Whether sailors, soldiers or airmen, those of whom we have the honour to be in medical charge become, if we wish, our friends and comrades throughout their service; where they go we go, and their health and physical well-being is not only our charge but is to us an open book throughout their service, wherein we may read, and perhaps even write, as we will. From their examination as recruits till they leave the colours their physical standards and their medical history are recorded and they are under our daily supervision. What would not our civil brethren often give for such an intimate knowledge of the past history of a patient? There is nothing like it, except, perhaps, in some schools and institutions and in relation to some of the notifiable diseases such as tuberculosis. The fact that the men, like ourselves, are subject to discipline brings in another element

of great value, inasmuch as it renders possible such things as systematic or periodical examination, the employment of uniform standards of procedure, &c., which are, as a rule, totally impracticable elsewhere.

As to the opportunities for medical research in connexion with this exceptional material there is no need for me to remind my brother officers of both the abundance and the variety of the morbid conditions which come under our observation in officers and men and among their wives and families. This is less appreciated, unfortunately, by many outside the Services, where there are still many misconceptions as to both the volume and the nature of our work; and it is not rare for us to read, or to hear, that our opportunities are meagre, that we see but the commoner ailments to which healthy young manhood is liable and that the bulk of our experience consists of the treatment of minor complaints and venereal diseases. This was not true even when I joined the Army, in 1887, and nowadays, in that Service, the volume and importance of the medical and surgical work compare favourably with that of all but the largest of the metropolitan or provincial hospitals. The change of policy which has resulted in the concentration of the troops in a smaller number of large stations has been followed naturally by a similar concentration of the medical organization, greatly to the benefit of the Army, the taxpayer and ourselves. I am naturally not so intimate with the situation in the Navy, the Air Force and the Indian Medical Service, but I have good reason to know that they are in most matters as favourably situated as ourselves, whilst the records of past meetings of this Section bear abundant evidence to the good use they make of their opportunities.

Medical and surgical material, then, is abundant and varied, both at home and abroad; we are most favourably placed for observing our cases from start to finish and, if we wish, for following them up afterwards.

Turning to another side, we can readily make use of our respective organizations for the employment of the technical aids to diagnosis and treatment with which medical science has been so greatly enriched in the last thirty years; and we gratefully acknowledge that we are able to maintain our equipment for theatre and laboratory in a condition well abreast of all modern requirements. Whatever tests may be considered as helpful to diagnosis or as accessory to treatment are readily available, and if the specialist and his tools cannot be brought to the patient, the patient if necessary is transferred to the hospital where he will find the pathologist, the radiologist, or other expert whose skill is needed. Further, should we feel that our own resources in skill or experience are insufficient in a difficult case we are indeed fortunate at home in being able to call upon one of our distinguished consultants, whose ready and valuable help it is impossible to acknowledge adequately.

We are thus able, in all but the most isolated stations at home or abroad, to investigate fully all our cases, to observe their progress accurately and to make permanent records in relation to any facts of importance. These are great assets for any medical man, and if we do not benefit by them to the full the fault is our own.

Such, then, being the present position as regards material and facilities in the Army Medical Service, and also, I am confident, in the sister Services, let us turn to the use which we are making, or may make, of them to further medical science by observation and research.

As to the past, each Service has a record of research of which it has every reason to be proud, and even our youngest sister Service has lost no time in making her permanent marks on medical progress. As I have said, I do not intend to enumerate even the more important and outstanding of these researches but will only point out that, for the most part, they were the work of men who had had the advantage of special training in some line and who enjoyed special facilities either in the way of exceptional access to fruitful material or in the use of well equipped laboratories. At the same time this was far from being the case in all instances,

especially in the past, when specialism and laboratories were rare, and many most valuable contributions to knowledge were made by men who had to rely solely on themselves and had to create and utilize their own opportunities.

What would not many of our forebears have given to profit by the benefits which we have inherited? Apart from the volume of new knowledge which lies to our hand, we all enjoy the further inestimable privilege of going through an admirable post-graduate course, just at the moment in our professional life when we can benefit by it best; that is, when we are old enough to have acquired a wide experience of men and of other lands and are still young enough to retain energy and ambition. Whether or no our professional predilections are sufficiently defined to lead us to seek for further special instruction in a particular branch, we are all of us, at the least, given the chance of bringing ourselves well up to date in our rapidly moving profession.

The point which I now wish to make is this. In my view, everyone who has reached this stage in his Service career is well equipped to make valuable original observations on many lines of professional work, either alone or with the readily available help of his specialist comrades. Not that I would for a moment suggest that such work need be deferred till then, but one recalls how, in earlier years, one feared to "slip up" by publishing observations or views which, through our inexperience, might either prove not to be novel or to be inadequately controlled and documented.

Apart from the desirability of attempting such research work for its own sake, and for the general advancement of our profession, there is, I imagine, little need for me to emphasize its value to the individual. Not only would it make his professional life infinitely more interesting, but there is always the chance that a particular investigation might end in bringing to light something of great importance, one result of which would be, if justice is done, as it usually is in the end, that the investigator's name would become associated with the observation and he would find he had taken a definite step forward out of the class of "also ran." I would, however, warn anyone who, on the strength of this advice, felt inclined to try his wings in this direction, that two qualities are essential to any chance of success—absolute honesty and infinite patience. One needs really something of the qualifications of the fly-fisher, for whom there is such hope in every cast that it will carry him happily through a blank day, leaving him with cheerful anticipations of the morrow.

One other word of counsel. Much careful and good observational work fails to obtain full acceptance and credit for lack of record of some observations or tests which a critic might consider essential to the acceptance of the conclusions. In such cases collaboration with a specialist colleague is most desirable and is most valuable to each.

Let us now consider for a few moments what kind of inquiries might be set about and in what manner the material which lies to our hand might be utilized. You will perhaps forgive me the presumption of attempting to advise beginners in this matter on the slender ground of having been, in my past life, a specialist in one branch. Putting myself, as far as I can, in the position of a young officer who has not as yet attempted anything of this kind, I should begin by asking myself, "in what line of professional work am I most interested and would most wish to become expert?" The answer, I am sure, would be clear and prompt. I should then sit down to think over the many branches of that subject, finally selecting one or two of them for a closer scrutiny. I should lay special stress on the cases which, in my own experience, had puzzled me and in which, for example, I had felt unsatisfied as to the current explanations of their ætiology or in which the treatment in common use had proved, in my hands, unsatisfactory. It would not be long, I fancy, before a certain number of such instances occurred to me. Of these I should select one or two and proceed to soak myself in the recent literature of the subject, incidentally

subscribing to some of the technical journals dealing with it. I should soon realize that many others had encountered the same difficulties and I should find myself stimulated by their new points of view and their own conclusions. By degrees I should, I am sure, find myself becoming more and more critical of these conclusions, so often expressed with dogmatic confidence, and I should begin to ask myself, "why does this fail to convince me?" or "how am I to reconcile this result with what has been recorded by X, Y, or Z?" Next in order comes the stage at which one begins to think "would it not be possible to settle the point if I were to do—what?" If one accepts the mental challenge, *that* is the starting point of a specific piece of investigation and one must then begin to plan the campaign. Assuring oneself, in the first place, that sufficient material is already available, or can be made available by a little private organization, one asks, "How can I make and record these observations in such a way that a clear-cut answer may be obtained to the questions I have asked myself?" In this it must be kept clearly in mind that you have to convince not yourself only but others who, when they come to read your work, will be quick to notice the absence of certain relevant details or the inadequacy of your "controls." It is impossible to take too much trouble over this planning of the inquiry, for, if every fallacy is not thought of beforehand and guarded against as far as possible, one may waste much effort and have to start afresh.

Unexpected difficulties, failures, and interruptions, are the daily bread of the inquirer, but, if met with cheerful philosophy, and still more if we are wise enough to have prepared more than one string for the experimental bow, we may confidently anticipate reaching a result worth communicating to a society or journal, and will have achieved an altogether new outlook on professional work and acquired that admirable thing—a new interest in life.

Each man has different tastes and different aptitudes, but, in the extremely varied work which falls to us in the Medical Services, it would indeed be strange if we could not find, within working distance, both the subject and the material for commencing such an inquiry as I have outlined. The subject of tropical diseases is bristling with unsolved problems of ætiology, of treatment and of prevention, and our opportunities in this line, when on foreign service, are unbounded. The Navy and the Air Force have, I take it, no lack of unsolved problems, special to themselves; while, in the Army, there are a crowd of morbid conditions, some of them of first-grade military importance, in which our special facilities should give us a better chance of adding fresh knowledge or of clearing up difficulties than falls to the lot of most of our brethren. Again, to the considerable number of us to whom preventive medicine makes a stronger appeal than clinical work, the difficulty will be to choose one out of the host of problems which are presented to us by the rapid development of this subject.

So far I have been speaking of the individual inquirer who wishes to choose and follow up for himself a particular subject. Let me now say a word or two on collective research, a method of inquiry which so far has not been very widely adopted in the Services. By this is meant that a selected problem is investigated by a number of workers in different places who follow an agreed plan and conform to certain rigid standards as to the material and the methods to be employed. I have always thought that there were great possibilities in connexion with this method, and that the conditions which should make for success were exceptionally favourable in the Medical Services. In the case of the Army our research organization is readily adaptable to such a method, and a certain number of such investigations have been commenced since the Directorates of Pathology and Hygiene were created. As no doubt you are aware, in each of these subjects our Director has the advantage of a technical Advisory Board to which highly qualified civilian experts have been nominated. At their meetings subjects possibly suitable for such research are examined, and, if one is chosen, the details of the inquiry, the methods to be employed, the mode of recording, collecting and analysing the results, &c., are fully

discussed and decided upon. The detailed plan is then communicated to the specialists in suitable Commands who get down to work on the subject, on a common plan and using a common technique. I may enumerate a few of the subjects so chosen, merely by way of illustration:—

(i) Influenza: the incidence of Pfeiffer's bacillus in the sick and in contacts, in the presence and in the absence of epidemics. The use of vaccines.
(ii) Latent sepsis: the value of vaccines preceding operation.
(iii) Catarrh. Inquiry into bacteriology and prophylactic use of vaccines.
(iv) Typing of strains of diphtheria, cholera and dysentery bacilli encountered in different countries.
(v) The Schick reaction.
(vi) Parallel testing of the Sigma and Wassermann reactions.
(vii) Sand-fly fever.

These and other subjects have been explored in this collective way, with substantial and encouraging results in some instances. I need hardly add, especially in the present difficult times, that we cannot command success; a particular epidemic may dwindle and disappear, or the other material may not be forthcoming in sufficient quantity. More frequently, however, it is one of these inevitable but irritating "exigencies of the Service" which has called a premature halt to a promising line of inquiry. I trust, however, that such efforts may not be abandoned, since these collective inquiries are of value not only because they multiply results and tend to accelerate progress but because the work and results of one observer form a useful check against those of another. Again, the mere fact that workers at a distance from one another are engaged on the same problem and confronting the same difficulties stimulates intercommunication, and tends to break down that feeling of isolation which may sometimes become so irksome when one is working alone.

Before leaving this subject I would add that the method is capable of being of service to our civil brethren. There are many inquiries of medical, physiological, or sanitary importance which, because we are very busy people and because the problems are not perhaps of very direct military importance, we have not undertaken in the Services. At the same time, thanks to the favourable conditions of which I spoke at the beginning of my address, the Army, Navy and Air Forces offer a field for their investigation under almost ideal conditions of observation and control. We have received, and continue to receive, so much ungrudging help and advice from our civil colleagues that we should indeed be ungrateful if we did not in return do everything that we could to assist them, whenever this is within our power. I am glad to know that something has already been done for them in this way, and I hope that we may be able to do more.

As regards research and observation of the more strictly clinical character, I may add that, in the case of the Army, we have now the great advantage of the advice and controlling direction of our own consulting surgeon and consulting physician, and I am confident that their assistance and counsel will, if required, always be most readily available.

To conclude, I have been urging upon you that we should endeavour to secure a larger output of medical research from the Services, and have suggested that this is well within the power of many who have not so far embarked on it. I have done so for the following reasons: First, because it is our bounden duty to leave nothing undone which we can do to maintain or improve the health of the fighting forces, and to anticipate and prevent medical catastrophes in the future, not only by utilizing new knowledge, but by adding to it. Secondly, because I know nothing better calculated to maintain a man's professional interests, as well as to keep him out of the grooves which may become so dangerously deep as our service advances. Lastly, it is only by contributing our full share to medical progress that we can hope to maintain the high prestige gained for our respective Services by those who have gone before us.

War Section.

President—Lieut.-General Sir WILLIAM LEISHMAN, K.C.B., K.C.M.G., F.R.S., A.M.S.

The Prevention of Scurvy in the Navy.

By Surgeon-Commander J. L. PRISTON, M.B., M.R.C.P., D.P.H., R.N.

BEFORE the year 1797 scurvy was very common in the Navy. In that year, as a result of the mutiny at the Nore, improvements were made in the accommodation and diet of the men. Fresh vegetables, meat and lemon juice were supplied more freely. In spite of this, scurvy continued to be a common disease for many years until, with the introduction of steam, voyages became shorter and fresh food was supplied as a matter of course, not as a rare privilege.

Before the year 1860 great reliance was placed upon juice prepared from the Mediterranean lemon as an antiscorbutic. This juice when freshly prepared by processes which did not destroy the vitamin C was proved in many cases to be effective, but the Admiralty always had great difficulty in getting reliable supplies from the Mediterranean. In some cases this was due to the dishonesty of contractors, in other cases lack of antiscorbutic power in the lemon juice supplied was due to the fact that its action was not understood at the time. The antiscorbutic power was ascribed to the citric acid contained in the juice, and in many cases the method of preservation destroyed all the vitamin C, so that the juice, although full of citric acid, was useless as an antiscorbutic.

About the year 1860 the Admiralty gave up trying to get good supplies from the Mediterranean and began to use lime juice prepared from the sour lime in the West Indies. It is now known that the fresh lemon is four times as powerful an antiscorbutic as the fresh sour lime. Moreover, the method of preserving Navy lime juice destroys all the vitamin C, so that the Navy lime juice as now supplied has no antiscorbutic power at all.

These facts were unknown in 1860 and were not discovered by experience, because scurvy had by that time become a rare disease in the Navy. Voyages had become much shorter and fresh food was provided regularly. The name "lime juice" had always been applied indiscriminately both to lemon juice and lime juice; it was thought that Navy lime juice must necessarily be a good antiscorbutic because it contained even more citric acid than the lemon juice obtained from the Mediterranean.

Arctic explorers, however, noticed from time to time as a puzzling fact that lime juice did not prevent scurvy. During the recent war the ætiology of deficiency diseases was investigated by a great many workers, and it was definitely proved that Navy lime juice was useless as an antiscorbutic. It was thought at first that lemon juice would be better. This view was based upon the fact that in the literature of the eighteenth and early nineteenth centuries many cases of protection from scurvy could be traced to the use of lemon juice. The Admiralty therefore arranged for lemon juice to be prepared by the method that is used in the case of lime juice. This juice was supplied to the Navy between 1918 and 1921, but it deteriorated rapidly and was shown experimentally to have no greater antiscorbutic powers than lime juice. Various samples of lemon juice preserved by commercial processes were investigated but none of them contained appreciable quantities of vitamin C. All commercial

processes involve prolonged sedimentation of the juice, or boiling or addition of preservatives, and the antiscorbutic factor is thereby destroyed.

Finding that preserved lemon juice was no better than lime juice as an antiscorbutic and that it did not keep well, the Admiralty decided in 1921 to rely for the time being on a plentiful supply of fresh vegetables and fruit to prevent scurvy. This disease has been very uncommon in the Navy for many years because the food normally obtainable is sufficient to prevent it. Lime juice is still issued as part of the ration, but no reliance is placed upon it as an antiscorbutic. It is intended merely as a safe and pleasant drink in hot climates.

Although a good mixed diet containing plenty of fresh food will not only prevent scurvy but will conduce to the health and efficiency of the men in other ways, it is proposed nevertheless to show that circumstances may arise under which it will be impossible to supply such a diet. A reliable antiscorbutic which can be preserved in a compact form will then be urgently required to prevent scurvy.

During the recent war only three definite cases of scurvy were recorded in the total force of the Navy between the beginning of 1914 and the end of 1918. Nearly all the ships were, however, employed in temperate climates and fresh food was readily obtained. In case of a war in the tropics very different conditions will be encountered. Ships will probably be based upon remote harbours where fresh vegetables cannot be procured in sufficient quantity. It will be unsafe to allow fruit and vegetables to be eaten uncooked on account of the danger from dysentery, enteric fever and intestinal parasites. Cooking under the cramped conditions of a ship's galley often entails prolonged stewing of vegetables, which destroys a large proportion of the antiscorbutic potency. For the main bulk of their food ships will be dependent upon supply ships bringing their food through hot weather from a great distance. This will entail the reduction of bulky food of low calorie value to a minimum, and such vegetable foods as can be supplied will inevitably be in poor condition.

An illustration of what is likely to happen may be found by considering the sickness returns of ships serving in the Persian Gulf. In 1909 and 1910 there was a severe outbreak of "ship beri-beri" coinciding with a period when the ships were kept a long time at sea, blockading the Persian coast. Munday recorded the improvement which followed better arrangements for supplying fresh fruit, vegetables and meat, but cases continued to occur sporadically until the outbreak of the recent war. This shows the difficulty of procuring fresh food, even under peace conditions, in some parts of the tropics. During the war over two hundred cases of beri-beri were recorded in the Navy, mainly amongst ratings serving in the Persian Gulf. It was generally agreed that lack of fresh vegetables was a predisposing factor. Many of the cases of beri-beri in the Navy have been of the atypical kind known as "ship beri-beri," a disease which is intermediate between beri-beri and scurvy. Lack of both vitamins B and C in the diet probably predisposes to this disease.

Underfeeding with vitamins has a lowering effect upon the general health even when the deficiency is not great enough to produce any definite disease. Lassitude, anæmia, debility, shortness of breath and hæmoptysis on exertion have been recorded as symptoms of relative insufficiency of antiscorbutic diet. Anæmia, lassitude and debility occur amongst naval ratings serving in the tropics even in peace time, and it is possible that lack of vitamin C in the diet may be responsible in some cases.

Vitamins A and B are easily preserved. Meat kept in cold storage or even preserved, condensed milk, suet and dried pulses are all compact foods of high calorie value and will no doubt form a large part of the diet of a fleet under war conditions in the tropics. If these are found to contain an insufficient quantity of vitamins A and B, cod-liver oil and yeast or marmite can be added to the diet easily. In the case of vitamin C difficulty is likely to be experienced because it is not easy to preserve.

Various forms of antiscorbutic which could be preserved have been recommended

for naval use. Tomatoes can be tinned by ordinary commercial processes in such a way as to retain one-half to one-third of the antiscorbutic power of fresh tomatoes. A ration of three ounces daily of freshly tinned tomatoes would probably be sufficient to prevent scurvy, but even this ration would entail a supply of two hundredweight daily to a ship's company of 1,200 men. Delf has shown that the antiscorbutic power diminishes on prolonged storage, and this deterioration would probably be increased at tropical temperatures. Some people do not like tomatoes, so that it would be difficult to be sure that every man ate his ration. There would be some difficulty in serving the tomatoes as prolonged cooking would destroy the vitamin C. Although tinned tomatoes would be an excellent addition to naval diet, they are bulky, of low calorie value, and expensive. They would not be a sufficiently compact antiscorbutic for a fleet carrying on warfare in the tropics.

Bassett-Smith concentrated lemon juice *in vacuo* and made up the resulting syrup into tablets with lactose and gum. These tablets kept well and retained considerable antiscorbutic potency at room temperature for a year, but they are unpalatable. The concentrated juice might be made in bulk and bottled. It keeps well and could be diluted and sweetened before issue. Unfortunately special apparatus is necessary for manufacture, as the acid juice attacks copper and lead. The apparatus would be costly and the syrup manufactured in bulk might prove to be less satisfactory than the samples prepared in the laboratory.

Dried orange juice and dried lemon juice are manufactured in America by the Merrell-Soule Co., and are said to retain antiscorbutic properties for a year. It would, however, be difficult to mix antiscorbutic in the form of a dry powder into a palatable drink for issue to a large body of men.

Zilva has prepared a decitrated and very much concentrated form of lemon juice with remarkable antiscorbutic powers. The process would be expensive to carry out on a large scale. It may be doubted whether the commercially prepared product would be as satisfactory as the samples prepared by skilled workers in the laboratory.

Davey prepared lemon and orange juice by slicing the whole fruits and mincing them together with their skins. The resulting pulp was filtered through muslin and the filtrate bottled. The juice contained a proportion of the rind oil, which acted as a preservative even without any sterilizing precautions, and the juice kept well even if the bottle was frequently opened. These juices retained from one-third to one-half the potency of fresh orange and lemon juice after storage for about eighteen months at room temperature. In cold storage they maintained a greater potency for over two years. These products could easily be prepared on a large scale, but they are fairly bulky. At least one fluid ounce would be required by each man daily, so that a three months' supply for a ship's company of 1,200 men would be about 700 gallons, which would take up about 300 cubic feet of space. The juice would have to be kept in cold storage in the tropics, as it deteriorates rapidly at 37° C.

Marrow-fat peas are a part of the ration at present supplied in the Navy. These can be germinated and are then equivalent in antiscorbutic power to fresh vegetables. If they were the only antiscorbutic available it is estimated that each man would have to eat about $\frac{1}{2}$ lb. dry weight daily; germination requires two or three days and a good deal of space; moulds are apt to grow on the peas whilst they are germinating and render them unappetizing. It would be difficult to persuade the men to eat such large quantities of germinated peas daily. There is a general prejudice against germinating seeds, which are usually regarded as only fit for pigs, and it would not be easy to boil over half a ton of peas rapidly in a ship's galley every day. Prolonged cooking or stewing would destroy the vitamin C. It appears then that there are objections to most of the antiscorbutics which have hitherto been suggested.

During the last eighteen months experiments have been made at Greenwich with a product which seems to be suitable in many ways for use as an antiscorbutic

in the Navy. This product is a concentrated orange juice manufactured by the Exchange Orange Products Co. of San Dimas, California. The juice is actually being manufactured at the present time on a large scale for use in fruit drinks. It can be obtained at a low price, because it is prepared from the fresh oranges where they are grown and is made in large quantities when oranges are plentiful. At times of glut, for instance, it is more profitable to preserve the orange juice than to sell the crop at low prices.

The juice is concentrated by evaporation at about 37° C. under a negative pressure equivalent to 28 in. of mercury. The low pressure enables the concentration to be carried out quickly at a low temperature in the absence of oxygen. The juice is not in contact with any metals meanwhile. For these reasons the vitamin C. is not destroyed in the process. Sufficient cane sugar to make 16 per cent. of the final product is added to it and the bulk of the concentrated juice is reduced to one-sixth or one-seventh of the bulk of the original orange juice. The cane sugar acts as a preservative and improves the flavour. No other preservative is used, and the product contains no lead or copper.

Batches of guinea-pigs were fed upon a diet containing no vitamin C. Some were fed upon this diet until they died of scurvy; these controls all died within four weeks. Other guinea-pigs were given various doses of the concentrated orange juice daily to protect them from scurvy. The majority of those receiving 0·3 c.c. daily were completely protected from scurvy until they were killed four or five months after the experiment began. The juice used had been shipped from America and kept at warehouse temperature for several months before it was used for feeding the animals. From these experiments it was concluded that the concentrated juice, when not more than a few months old, had at least three times the potency of an equal volume of fresh orange juice.

Storage of the same sample of concentrated juice at about 8° C. for more than a year impaired the antiscorbutic power slightly; it was still twice as potent as fresh orange juice. The same juice stored at room temperature in a warm room for forty-two weeks was roughly equal in potency to an equal volume of fresh orange juice, but it became noticeably darker in colour and the flavour was impaired. Storage of the juice at 37° C. caused it to become dark and unpalatable rapidly, and all the antiscorbutic power was destroyed.

The concentrated juice could be delivered to ships in any part of the world with a potency at least three times as great as that of an equal volume of fresh orange juice. It is probable that this potency could be maintained almost unchanged for a long time if the juice were stored at 0° C. 15 c.c. of fresh orange juice daily would probably protect a man from scurvy, although his diet contained no other vitamin C. It is therefore anticipated that 5 c.c. daily of this concentrated orange juice would be a sufficient ration for an adult man having no other supply of vitamin C. This ration might be issued as five-eighths of a fluid ounce of the concentrated juice per man twice weekly, which would require about 9½ English gallons weekly for a ship's company of 1,200 men. The ration might be issued upon order of the medical officer when other antiscorbutics were scarce.

If ships were employed under war conditions in the tropics, their supplies would probably have to be sent for long distances in supply ships; each warship would probably have to carry food for three months on board. This would necessitate reduction of bulky food of low calorific value, such as vegetables and fresh food, to a minimum, which could only be done, without impairing the health and efficiency of the men, by providing vitamin C in some other form.

No antiscorbutic so far investigated has been able to withstand prolonged storage at 37° C., and even at room temperature most antiscorbutics deteriorate to one-half or one-third of their original potency within a year or two. In the tropics it will

probably be necessary to keep any antiscorbutic in cold storage, and it is in the tropics that an antiscorbutic will be most required. For this reason it will be necessary to use a concentrated antiscorbutic, and few such substances are available at a reasonable price; 120 English gallons of concentrated orange juice would be a supply sufficient to make two issues weekly for three months to a ship's company of 1,200 men. Other antiscorbutics, such as fresh vegetables and meat, would probably be available to some extent even under war conditions, so that one-half or one-third of this amount, say 50 English gallons, might be sufficient, and this, if suitably packed, would take up a negligible amount of room in the cold storage of a warship.

It is essential that an antiscorbutic should be palatable. The concentrated orange juice when fresh or kept for prolonged periods in the ice chest may be diluted to make six or seven times the original volume. It then has the exact appearance and flavour of fresh, sweetened orange juice. It is extensively used in this country for making orange drinks at soda fountains. Before issue to the men it would probably be best to dilute the product so as to make each man's bi-weekly ration about four or five ounces, or it could be diluted more and made into a long drink, but is inclined to be somewhat mawkish if too much diluted. This difficulty can be met by adding essence of orange to increase the flavour.

Storage of the concentrated juice at 37° C. caused it to turn dark brown rapidly, bubbles of gas being evolved. The change of colour was also noticeable after prolonged storage at about 19° C., but was negligible when the juice was stored in the ice-chest. The change of colour is apparently due to a reaction between amino-acids and reducing sugars present in the orange juice, with liberation of CO_2 from the carboxyl group of the amino-acids. The residue of the amino-acids combines with the sugar molecules, giving rise to a variety of dark-coloured compounds of the classes called melanoidins, humins, &c. A similar reaction takes place when sweetened condensed milk, molasses or malt extracts are kept at warm temperatures. The CO_2 evolved caused some of the bottles to froth when they were opened, but no bubbles of gas were seen in the bottles kept in the ice-chest or at room temperature. The loss of antiscorbutic potency seemed to be proportional to the change in colour; possibly the vitamin C is in some way destroyed by the complex chemical reactions taking place.

Micro-organisms were unable to grow in the concentrated juice, no matter how it was stored nor how many times the bottles were opened. An occasional colony of *Bacillus subtilis* or *Bacillus mycoides* or *Staphylococcus* was all that could be found on plating out samples from many bottles. Samples of the orange juice were heavily inoculated with various moulds and with dust and dirt; samples were also exposed to the air of the laboratory for hours and then incubated at 22° C. and 37° C. No growth of organisms took place and the only change noticed was that the juice dried up into a solid cake. When the concentrated juice is diluted with water it ferments after standing for a few days, and moulds and bacteria grow in it readily. They are apparently restrained from growing in the concentrated juice by its high specific gravity and the high osmotic pressure of the sugar contained in it. The juice should therefore be diluted immediately before it is required and not allowed to stand long in the diluted state.

The concentrated juice is sold in cases containing four jars, each of one American gallon, i.e., 128 fluid ounces; the price, duty free, for 126 cases or more, is about £1 1s. 6d. per American gallon. It is estimated that the weekly ration of one man would be 1¼ oz., which would cost 2½d. One man's weekly ration of lime juice (7 oz.) costs 3·3 pence, and it is necessary to add an ounce of sugar to each ounce of lime juice. This increases the cost of one man's ration to about 4d. a week. About £9,000 per annum is spent on lime juice for the Navy, and to this, sugar, costing nearly £2,000, is added before issue. At this price a pleasant drink is supplied to the

men which is of negligible dietetic value. If the issue of lime juice were abolished and concentrated orange juice were substituted for it, a potent antiscorbutic would be issued instead of a useless beverage, and about £4,000 per annum would be saved. The makers of the orange juice would probably sell the juice to the Admiralty at an even lower price than that quoted above, because of the excellent advertisement it would be of their wares.

If this orange juice or any other antiscorbutic were adopted, it would be advisable to test a sample of each delivery on guinea-pigs to see that the antiscorbutic potency was maintained.

Finally, it may be considered a disadvantage that the juice is manufactured in America and not in England. It is, however, essential that an antiscorbutic should be prepared from fruit as soon as possible after it is picked; oranges and lemons, which are most suitable as crude materials, will not grow in England, and the cost of setting up plant to manufacture antiscorbutic specially for naval use would be prohibitive.

Discussion.—Captain D. GORDON CHEYNE, M.C., R.A.M.C., drew attention to the high incidence of scurvy in the Mesopotamia campaign and to the occurrence of the disease in every theatre of war during 1914-18. The pre-scorbutic condition should be recognized, and vitamins should be considered not only as regards their specific functions but also as regards their function in maintaining health. He saw difficulties in procuring the orange juice, and suggested that an equally good product could be obtained in this country if manufacturers would take up the matter. The use of germinated pulses should be considered, as here was a definite food rich in both vitamin B and C. He quoted Wiltshire's experiments in treatment of scurvy with lemon juice and germinated pulses, when the cases on a diet of germinated pulses improved rather more quickly. He asked how the figure of 8 oz., mentioned as the daily dose of germinated beans or peas required in the prophylaxis of scurvy in man, had been arrived at by the author.

Squadron-Leader G. STRUAN MARSHALL asked the author for information as to the type of orange used in preparing the American concentrated juice, whether sweet or bitter, and the parts of the fruit used. He pointed out the disparity between the weight/dose ratios in the guinea-pig and in man, and presumed that this was accounted for by some factor other than body-weight. He thought that the fact that this juice was manufactured solely in the U.S.A. was a great disadvantage from the point of view of use in the British Services, and asked whether it was not possible for its manufacture to be carried out in a British Possession, the early stages of commercialization being subsidized to a small extent by the State if necessary. He asked whether the author could confirm a statement that fruit which had been dried and had thus been deprived of most or all of its antiscorbutic value could be restored by the replacement of the lost water.

Colonel J. C. KENNEDY said that Commander Priston's interesting paper raised very many points of discussion, and that he would briefly refer to one aspect only. The discussion was tending to centre round the respective merits of fruit juice and germinated beans as methods of administering the antiscorbutic principle. It was recognized that a scorbutic condition could be readily induced in long-continued and debilitating diseases such as, for instance, Mediterranean fever if the diet was not carefully regulated. In such cases fruit juice was a much more suitable method of administering the antiscorbutic principle. He had understood that the fresh juice of oranges as obtained in this country was of high vitamin content, but the lecturer had emphasized the importance of collecting the juice as soon as the fruit was picked, and he (Colonel Kennedy) said he would be glad of information as to the degree of deterioration that was to be expected in the juice of oranges imported into England as compared with that of freshly-picked fruit.

Fleet-Surgeon W. E. HOME said that the fact of the success of lime juice in preventing scurvy up to sixty years ago, and that of its apparent failure since, constituted a great lesson for all officers concerning themselves with research. In the Baltic, during the Crimean War, a French ship, without lime juice, suffered severely from scurvy until an English medical officer arranged for an issue of lime juice, and then the outbreak of the disease ceased. This was traditional during his (the speaker's) early service, so when Dr. Forbes Mackay, medical

officer to Stefansson's Polar Expedition in 1913, said that lime juice was no preventive for scurvy, that statement seemed hardly credible. Yet it was true, verbally; but the term "lime juice" had, meanwhile, changed its application. Before 1860, lime juice meant "lemon juice," which did prevent scurvy, but after that date, lime juice meant "lime juice," which exercised but a trifling preventive power, if any, over scurvy. In the conduct of all researches it was very important to be sure that words were always employed to signify the same substances or ideas.

Surgeon-Captain BOND, R.N., said that the results of the author's work were promising, and they indicated that a trial should be given to the use of the orange juice in such places as the Persian Gulf, and the Chinese and West African rivers. Nevertheless, two practical difficulties suggested themselves to him (the speaker): first, the abolition of the present Navy lime juice, which, though useless as an antiscorbutic, was much appreciated by officers and men stationed in the tropics as a pleasant drink and one to which they had long been accustomed. Secondly, there was the impossibility of obtaining cold storage in small detached ships in out-of-the-way places at a distance, probably both in peace and war time, from a big ship with sufficient cubic space for cold storage.

Dr. J. KINGSTON BARTON, speaking as a civil practitioner interested in the necessity for an efficient antiscorbutic in dealing with the hand-feeding of infants—more especially where any tinned, bottled or sterile food was used—said that Surgeon-Commander Priston had treated the subject very ably. Judging by the careful details he had given of the concentrated orange juice made in America he had evidently found a production that excelled (1) in efficiency, (2) in reduction in bulk—important because of the limited storage space in warships, (3) in potency when kept in trying temperatures, and lastly (4) in comparative cheapness. Although in his (Dr. Barton's) opinion no expense ought to be spared that conduced to the health of the men upon whom our daily existence depended by their command of the sea, he (the speaker) was surprised to hear that lime juice was till so recent a date still in use in, and prepared by, the Royal Navy, for it seemed a very long time since the naval authorities themselves had found that the fruit of the lime of the West Indies was almost useless as an antiscorbutic. It had been proved that it was only the *Citrus medica* var. *limona*, or common lemon of India and the Mediterranean, that had the greatest potency as regarded the item of vitamin C; recently, too, it had been shown that the swede (turnip) was equally as efficacious as the lemon. Seeing that South Africa produced such a fine orange crop, the authorities there might be asked to produce a preparation similar to that made in California, and we should thus have a product from within the Empire. Surgeon-Commander Priston had referred to some recent work done by Dr. Zilva on the preparation of concentrated extracts of vitamin C from fresh lemons, the potency of which was stated to be at least one hundredfold or even many hundredfolds stronger than the ordinary dose of a fresh lemon. Particulars of these researches would be found by referring to the *Journal of Biochemistry*, part 4, 1925, and also to the *Journal of Industrial Chemistry* for 1925.

Sir WILLIAM LEISHMAN (President) said that Commander Priston's admirable paper had elicited an excellent discussion. He (the speaker) remarked that it was clear that scurvy could be prevented in a number of ways, all depending on the same principle—the provision of the vitamin which was lacking in the diet. The orange extract advocated appeared to be very effective and to present distinct advantages for use on board ship. But he looked forward to the day when the intensive research now going on all over the world in biochemical laboratories would result in the chemical identification and the isolation of the vitamins themselves. If this work was successful it would enormously simplify the problem and would replace the somewhat cumbrous methods now required.

He asked Commander Priston whether any work was on record showing the periods in the life of an orange at which the vitamin appeared and at which it was present in greatest amount. In view of the high bactericidal power of the orange extract described by the author, he wondered that he had not claimed it as a useful alternative to some of the commoner antiseptic agents, and thus fortified his case on the economical side.

Surgeon-Commander PRISTON (in reply) stated that it was estimated that 8 oz., in dry weight, of germinated peas would be required daily by each man as a prophylactic dose, for the following reasons: the prophylactic dose of fresh lemon juice was probably about 15 c.cm.; 5 grm. dry weight of germinated peas were equivalent to 1 c.cm. of lemon juice. Forty-five grammes dry weight of raw germinated peas would therefore be required daily. About

four-fifths of the antiscorbutic power would probably be lost in cooking for half an hour, so that 225 grm. (8 oz.), in dry weight, of cooked peas would be required daily. Wiltshire, from his results when treating cases of scurvy in Serbia, concluded that 4 oz. of cooked, germinated haricot beans were superior to 4 oz. of fresh lemon juice, and suggested 2 oz. of germinated haricot beans as a sufficient prophylactic dose; he admitted that it was difficult to get the men to eat them, and no details were given of the diets which his patients received or of their weights during treatment. Stevenson, writing two years later, found germinated haricot beans unsatisfactory in the treatment of scurvy, although he had fair results with germinated peas (8 oz. daily). He had equally good results with tinned fruit, which probably contained but little vitamin C. His results with lemon juice and lactic acid milk were better. The diets of the patients and their weights were recorded, so that it seemed reasonable to attach more weight to Stevenson's findings. Germinated peas certainly had valuable antiscorbutic powers; they were not, however, an ideal antiscorbutic because of the large amount which must be eaten, the difficulty of preparing them and the prejudice which existed against eating germinating vegetables. It was not legitimate to reason that because a guinea-pig weighing 300 grm. required 0·3 c.cm. of antiscorbutic daily a man weighing 60 kg. would require 60 c.c. daily. The guinea-pig required a relatively large amount of antiscorbutic, the same quantity as a monkey weighing ten times as much, and it was probable that man resembled the monkey more than the guinea-pig in this respect. A growing child required 10 to 15 c.cm. of fresh orange juice daily and an adult man did not probably require much more. Dried fruits were believed to lose their antiscorbutic quality by oxidation of the vitamin C during the drying process; tinned fruits as a rule contained little antiscorbutic substance but tomatoes retained their potency. The high natural acidity of the tomato made the vitamin C more stable. Davey kept oranges and lemons in cold storage, and so long as the fruit remained edible the antiscorbutic power was not impaired, but after a few months nearly all the fruit became mouldy. Little was known concerning the stage of ripening in fruits at which vitamin C was most plentiful. It was certainly present both in the ripe and unripe fruit. The concentrated orange juice was made from the pulp only of oranges. The rind was really the most valuable part of the fruit, and the juice might be regarded as a by-product left over after the valuable skins had been removed. An orange juice containing the rind oil was therefore difficult to obtain and was more expensive than ordinary orange juice. Many potent antiscorbutics could be prepared in this country if expense were no object and machinery were set up to manufacture them; there was no certainty, however, that any particular product when manufactured would be satisfactory. If it were not satisfactory the money spent on machinery for manufacture would have been wasted. The concentrated orange juice made in America could be bought cheaply, and if it were found satisfactory after trial, arrangements could be made to produce a similar product within the British Empire.

War Section.

President—Lieut.-General Sir WILLIAM B. LEISHMAN, K.C.B., K.C.M.G., F.R.S., A.M.S.

Visual Problems in regard to Flying and Industrial Fatigue from a Service Standpoint.

By Wing-Commander EDWARD CECIL CLEMENTS, L.R.C.P.Lond., M.R.C.S.Eng., R.A.F.

IT is now nearly eighteen years ago that I called attention, in the *British Medical Journal* of December 8, 1906, to the effect general fatigue may have on judgment of distance, referring in that instance especially to motor accidents.

To-day, in the light of greatly increased experience, I wish to call your attention to the importance of visual problems in regard to flying and industrial fatigue from a Service standpoint.

Ever since commencing practice as an ophthalmic surgeon, I have been extremely interested in certain abnormalities which appeared to be associated with lack of success in certain occupations. Gradually I came to the conclusion that if these abnormal states were not actually *caused* by such occupations, they were certainly aggravated by them, and that in so much as these abnormalities were either developed, or those existing already in very minor degrees were increased, so, too, the quantity and quality of the work produced were detrimentally affected in direct ratio. These abnormalities (namely, defects in binocular vision or muscle balance) amounted in some cases to an actual physical disability and were liable to affect the individual's general health, and, in some instances, his or her mentality. Conversely, I formed a very strong opinion that success, or average efficiency, in most so-called "eye work," depends largely upon normal ocular muscle balance leading to true binocular vision, this being so well developed that it is maintained even under conditions of stress.

I mention as examples of the occupations under consideration, those of the bank clerk, engineer, architect, draughtsman, and copying typist, in other words, all those forms of daily employment involving fine and precise manipulation. Investigation of the cases which came before me demonstrated in almost every instance the presence of some muscular lack of balance, which I eventually concluded was associated directly with the liability to a breaking down of binocular vision, followed, in some cases, by constitutional symptoms. Such breakdowns were frequently found after a greater stress of work than usual, e.g., in the instance of bank clerks at, and after, half-yearly and yearly "balance" periods.

In 1916, with the great increase of aerial activity in warfare, many aerodromes were established in the neighbourhood of my unit, and an increasing number of pilots came before me who, owing to non-success in flying, *particularly in landing*, were thought to have, possibly, some defect of vision. I soon became alive to the fact that there appeared to be a similarity between these defects and those previously met with in civil life, for some pilots presented themselves complaining of similar symptoms, the real existence of which was verified on examination in the great majority of cases.

Again, apart from flying, certain officers and men from other branches of the Service performing special kinds of work,—such as gunnery officers and "spotters,"—were among my patients. Practically one and all presented similar results on

examination, that is, the great majority were found to have normal vision and refraction, or very slight and negligible errors, but all exhibited more or less muscular imbalance, or weak binocular vision, or both. *The most striking feature of these cases, however, was that their previous occupations in civilian life were almost invariably of the same or similar groups as those to which I have referred.*

I obtained permission to investigate the matter, as at that time I had no knowledge of flying or the manipulations necessary for the art of flying. These investigations revealed that between 75 per cent. and 80 per cent. of the flying accidents admitted to hospital from neighbouring training schools were the result of unsuccessful attempts at landing. Further, of all the manipulations necessary in the preliminary training of the pilots the most difficult to acquire was the art of landing satisfactorily.

To follow up this investigation, it became necessary to employ a series of routine tests in order to bring out the various factors which appeared to be present and which required elucidation. Owing to the pressure of routine work it was essential that the apparatus for the tests should be portable, the tests simple, easily carried out, and capable of standardization. The tests selected have since been maintained, and are at the present day those employed in the examination of cadets and candidates for admission to the Royal Air Force.

The assessment of ability to succeed as a result of the response to such tests is based on the review of large groups of known good, bad, and indifferent pilots as judged by the executive officers.

I now propose to give you the tests employed, the reasons for their employment, and the significance attached to responses received; I will show statistics of good and bad landers assessed in accordance with the results of tests, and will also give the results of an investigation in an industry assessed on similar lines, with a comparison of the liability to accidents of each group.

Remarks on Tests Employed.

In considering the question as to whether a candidate is likely to attain success in flying, especially in landing, our attitude is that, as far as possible, we should attempt to find out whether the whole visual apparatus is working at its optimum efficiency. To ensure this it is necessary that there should be:—

(1) Good co-ordination of extrinsic muscles, allowing both eyes to fix exactly the object looked at.
(2) Efficient focusing power of intrinsic muscles.
(3) Efficient reception on corresponding areas of both retinæ.
(4) Efficient transmission, central reception and judgment.
(5) Efficient effector muscular response (hand, foot, or both).

Lack of above requirements has been found to account for:—

(1) Inability to land aeroplanes.
(2) Lack of manual dexterity or clumsiness at certain trade occupations.
(3) Lack of skill at games requiring "eye" for truly efficient performance.
(4) Loss of efficiency of performance in acts such as above, due to the effects of fatigue, illness and various other causes.

Convergence power gives an estimate of the co-ordinative control and capacity to resist fatigue. It will be noted that distinction is made between responses (2) and (3).[1]

[1] (2) Represents a longer duration of loss of convergence power with acquired neglect of one eye and fixation of the other (i.e., bad habit formation). (3) Represents the recent loss of convergence power without having acquired neglect of one eye and fixation of the other.

Cover test gives an estimate of the prevailing condition of binocular fixation; the RAPIDITY of any re-adjustment necessary is a fair estimate of the mental "DESIRE" for binocular single vision (i.e., effectiveness of reflex arc).

Red-green Test.—This test gives (i) an estimate of the basic error liable to be present in any judgment of depth dependent on the axial ocular movements made in fixing first one object and then another situated in different planes; (ii) and (iii) an indication of uniform delivery of centrifugal impulses received or a *break in the chain* (i.e., liability to become monocular).

Bishop Harman Test.—This is a direct standardizable measure of the power to maintain binocular vision under an increasing disability, and being a test at average working distance allows bad habits acquired from occupational pursuits to influence the test.

TESTS.

Test for Convergence Power.

Hold a pencil in front of the patient at about 1 foot from his eyes, with the point on a level with the root of his nose. Tell him to fix the point, then steadily move it forward, watching what happens to his eyes as they converge. The following results may occur: (1) Both eyes may converge, fixing the pencil until it gets within an inch or two from the root of the nose—that is, no want of convergence. (2) One eye may continue to fix up to an inch or two from the root of the nose, but the other will cease to follow, and may turn outwards at any distance from the nose—the patient sometimes stating that he sees double, sometimes not remarking on this point. (3) On convergence breaking down, neither eye may fix, and he may look into the distance, stating he sees double anywhere inside ten inches; further, he may resist by throwing back his head and complaining that it hurts him.

Convergence power is estimated by giving the following values; 2 in. or under, very good, possibly excessive; 2 to 3 in., good; 3 to 4 in., fair; 4 in. and over, poor.

Cover Test for Muscular Defect.

Again ask the patient to fix a pencil, held in a similar manner at about 1 ft. from the nose, and with the other hand to cover one eye with a card, move the pencil from side to side, bring it finally to the centre and then uncover, watching whether the eye moves on uncovering. Repeat the test for the other eye in a similar manner. A perfectly balanced pair of eyes will remain fixed on the pencil whether one is uncovered or not, whereas movement inwards or outwards on uncovering ("latency") shows some lack of balance.

If there is a convergent or divergent latency, it is described as slight, medium, or marked, and the response to the uncovering may be rapid, medium, slow, or with no recovery. There may also be a pause before recovery commences; this is charted as "Lag," e.g., latent divergence—lag—slow.

Red-green Test at 20 Feet.

The essential feature is that a suitable tint of red glass in one eye will cut out any rays of light from a green glass, and, vice versa, green glass in the other eye will cut out red rays. A slot $\frac{1}{2}$ in. wide by 5 in. long is glazed in the upper $2\frac{1}{2}$ in. with red glass and the lower $2\frac{1}{2}$ in. with green. The person under examination—wearing a pair of reversible frames, glazed red in one eyepiece and green in the other—is told to look at the slot illuminated from behind and asked to state what he sees.

(*i*) *Two lights*:—(*a*) In their proper position, i.e., perfect alignment of visual axes and correct ocular muscle balance; (*b*) with definite displacement up or down and/or right or left, i.e., *hyper-* or *hypo-* and/or *eso-* or *exo-phoria*; (*c*) one or both of which wanders from its original position and back again, i.e., a tendency to *aphoria*, but with some or full power of correction.

(*ii*) *At first two lights;* then an occasional disappearance of one of them, either the same one all the time, or the two alternately, i.e., mastery of one eye, either continuous or alternating, with neglect of the other.

(*iii*) *Either colour singly*, but never the two together:—(*a*) Red and green alternately, i.e., alternate fixation with suppression of the other image.

It may happen that the two colours may be superimposed and fused into one image. Reversal of the frame obviates this difficulty, as the colours are then widely separated.

The nature and amount of displacement indicate the quality and quantity of the heterophoria thus revealed.

A true exophoric case may give a temporary esophoric displacement owing to over-compensation, but, as fatigue sets in, the image appears to swing through orthophoria to the exophoric position.

Stress will be laid on the significance of (ii) and (iii).

Bishop Harman Diaphragm Test.

The essential principle of the test is the estimation of the relative capacity of individual subjects to maintain an even ocular muscle balance (and therefore, binocular *single* vision) under increasing disability by progressively diminishing the overlap of the binocular fields of view; further, the test aims at so standardizing the conditions as to produce an absolute estimate of this capacity.

The instrument consists of a rod, one end of which is free and bears a T-piece, shaped to fit the upper lip, to which it may be pressed by means of a handle fixed below the rod. At the other end, 44 cm. away, is a vertical card-holder in the plane at right angles to the rod. Between these, 11 cm. from, and parallel to, the card-holder, is a diaphragm in which a rectangular aperture is cut, through which the subject views the test-card. The aperture is capable of being widened or narrowed at will by means of two shutters, one on either side of the opening, worked by a right-and-left-handed screw, which is rotated by means of a milled head. Movement of the shutters operates a pointer, registering on a quadrant scale, which can itself be adjusted to the widely varying pupillary distances of individual subjects.

With wide-open diaphragm, all the figures on the test-card—say 1, 2, 3, 4, 5, 6, 7—can be seen by both eyes together, but as the edges of the diaphragm move towards each other, this binocular overlap becomes more and more reduced until finally there remains nothing in sight which is common to the two eyes.

It will be realized that this instrument is of great value, for not only can it be readily standardized for all variation in pupil distance but also it can demonstrate the variation in the "desire for binocular view" in one particular case from time to time.

A considerable amount of valuable information can be obtained by asking the subject to say precisely what happens to the figures when the shutters of the diaphragm move nearer and nearer together. For instance, he may state that:—

(1) The test-card is being "cropped" from one or other side, i.e., the figures at either end begin to disappear, indicating *suppression* of one or other image.

(2) The middle figures tend to crowd together and mix up, indicating *esophoria*.

(3) The figures divide and the centre figure is duplicated, and even a black bar appears between them, indicating *exophoria*.

(4) Some of the figures take a higher or lower level, indicating *hypophoria* or *hyperphoria*.

Or finally:—

(5) A black bar appears, obliterating the middle figure, but the rest remain in the proper relative positions, indicating that the overlap has been entirely cut down, and that there is a negative gap which is represented by blackness; in such a case the reading will be below zero, and indicate a *perfect control of balance*.

I repeat that the Bishop Harman test has proved invaluable as a check on the others above mentioned. It has been found that a reading of "3" on the arbitrary scale is a "border-line" one, and that 5 is bad. First-class landers usually give a reading of zero or below; average landers, zero to 2; doubtful landers, 2 to 3; whilst those giving readings of 3 to 5 or more, fall into the category of "bad landers."

In learning the art of flying it must not be assumed that there is anything in the manipulation necessary to attain perfection that is beyond the skill of the average individual met with in ordinary life. It is only in forming the necessary judgments for such manipulations that he comes across difficulties, and these difficulties are due to the fact that he has stepped into a world of altered conditions. These conditions are primarily visual in character.

(1) Immediately the aeroplane loses touch with the ground, the pilot loses the one known definite quantity necessary in the judgment of distance to which he has always been accustomed, namely, contact with the ground.

(2) All verticals are more or less foreshortened; therefore, the size of known objects will be varied from those of previous experience.

(3) Shadows of objects will be viewed from a totally different aspect.

(4) The speed at which the pilot is travelling is greater than any he has ever experienced. It may be taken as generally true that, the faster a machine flies in the air, the faster is its landing speed. Speed is often the last straw in a border-line case.

(5) The airmen's eyes are liable to stress and strain due to centrifugal force which, if continued under certain conditions, may render him incapable of correct judgment, and even mentally irresponsible. Further, there is the fact that the blood-supply to the third nucleus is one of the most inefficient of the whole brain and is especially liable to be affected by effects of "G" and splanchnic-pooling as a result of "G."

Pathological Basis for Defective Oculo-Muscle Balance.

Loss of convergence power and lack of muscular balance may be associated with:—

(1) Recent influenza and debilitating diseases.
(2) Recent accident involving concussion.
(3) Neurasthenia.
(4) Stress of service—fatigue of long hours at high altitudes (i.e., oxygen want).
(5) Climatic conditions (i.e., where glare is prevalent).
(6) Ground duties involving return to occupational pursuits, such as technical, i.e. engineering drawing and design.

These cases may be temporary, but I should like to point out that the longer the time taken to recover the more likelihood is there of bad habits being acquired, and the possibility of their passing into permanent disabilities, unless steps are taken to re-educate the various centres involved to a proper functioning.

[Slides were shown giving statistics of: (*a*) Good and bad landers, with regard to their responses to the tests. (*b*) Groups of cases in departments of various industries where the accident liability is known, and responses to tests contrasted with number of accidents in subgroup.]

I am indebted to Mr. Eric Farmer, of the Industrial Research Board, for the statistics given in Departments A and B. The results of the tests were sent to me for assessment and then grouped according to accident liabilities.

The Relation of Heterophoria to Bad Landings.

Series I.

Seventy-two pupil pilots turned down for bad landings by the special officers (wing-examining officers) appointed by the executive authorities for testing the flying capabilities of doubtful pupils.

Everyone in this series was examined by Wing-Commander Flack, or his representative, and passed as physically fit (i.e., no unfits are included in the table).

(*a*) The average age was 22 years.
(*b*) Average hours dual = 11¼.
(*c*) Average hours solo = 8½.
Forty-two of these were not allowed to go solo.

(It may be accepted that in war time the duration of dual instruction did not as a rule exceed five to seven hours without the pupil being referred to the special officers mentioned above.)

Of these 72, 40 definitely stated to be "good in the air but unable to land."
22 were stated to "fly badly as well as being unable to land."
6 were stated to be "unfit for flying and unable to land."
2 were stated to be "suffering from nerves as well as being unable to land."
2 simply noted for "bad flying."

72

In twelve cases the "bad landing" was confirmed by further flying tests at the Hendon medical flight.

Assessment with Regard to Heterophoria.

0 = *nil.*		
0 = border-line.		
4 = +	= 5·5 per cent.	
19 = + +	= 26·3	,,
41 = + + +	= 56·9	,,
8 = + + + +	= 11·1	,,
72	99·8	,,

96 per cent. within standard of vision required.

Series IIa.

397 civilian pilots examined at the Aviation Candidates Medical Board.
These are consecutive, only "unfits" and incomplete examinations being omitted. They were examined under the same physical standards as regards fitness as Series I, and are therefore physically comparable.
Average age = 24.
Average hours flown per pilot = 923.

Assessment with Regard to Heterophoria.

387 = *nil*	= 97·5 per cent.	
3 = border-line	= 0·7	,,
4 = +	= 1·0	,,
0 = + +	= 0·0	,,
0 = + + +	= 0·0	,,
3 = + + + +	= 0·7	,,
397	99·9	,,

Series IIb.

124 "good landers" (civilian), survival of the fittest.
This group was selected as the best possible example of "good landers," and is made up from amongst those civilian pilots of Series IIa who renewed their certificates and flew in between, and therefore by the commercial test must have landed their machines and passengers satisfactorily. Though the machines were mostly of a slow type they were flown

in all weathers and for long hours. Average flying hours per pilot = 1,223. All the members of this group are included in Series IIa.

Assessment with Regard to Heterophoria.

123	=	Nil	=	99·1 per cent.
1	=	Borderline	=	0·8 ,,
0	=	+	=	0·0 ,,
0	=	+ + ...	=	0·0 ,,
0	=	+ + + ...	=	0·0 ,,
0	=	... ...	=	0·0 ,,
124				99·9 ,,

93·4 per cent. within visual standard required.

Department A.

Group of 17 cases; some of the subjects had sustained no accidents, and others a varying number of accidents. These were examined by means of the red-green test, the results of tests being charted as follows:—

(1) Hyper- or hypophoria.
(2) Eso- or exophoria.
(3) Neglect of one or other image or alternating neglect.

	Total number of cases	17		
	Total number of accidents	29		
	Average per person			1·7
(1)	Number giving hyper- or hypophoria	8		
	Total number of accidents for this subgroup ...	28		
	Average subgroup			5·5
(2)	Eso- or exophoria	6		
	Number of accidents	24		
	Average			4·0
(3)	Neglect	8		
	Number of accidents	25		
	Average			3·1
(4)	Combined { Hyper- or hypo- and eso- or exophoria	8		
	{ Number of accidents	28		
	Average			3·5
(5)	Combined { Hyper- or hypophoria and neglect ...	5		
	{ Number of accidents	22		
	Average			4·4
(6)	Combined { Neglect and eso- or exophoria ...	5		
	{ Number of accidents	22		
	Average			4·4
(7)	Combined { Hyper- or hypophoria, eso- or exophoria and neglect	5		
	{ Number of accidents	22		
	Average			4·4

Department B.

Group of 23 cases, in some of which the subjects had no accidents, and in others there was a varying number of accidents. These were examined by means of the red-green test—the results of tests being charted as follows:—

(1) Hyper- or hypophoria.
(2) Eso- or exophoria.
(3) Neglect of one or other image or alternating neglect.

Total number of cases	23		
Total number of accidents	159		
Average per person			6·9

(1)	Number giving hyper- or hypophoria	6		
	Total number of accidents for this subgroup ...	81		
	Average subgroup			13·5
(2)	Eso- or exophoria	12		
	Number of accidents	105		
	Average			9·7
(3)	Neglect	7		
	Number of accidents	89		
	Average			12·7
(4)	Combined { Hyper- or hypo- and eso- or exophoria	4		
	Combined { Number of accidents	53		
	Average			13·25
(5)	Combined { Hyper- or hypophoria and neglect ...	4		
	Combined { Number of accidents	62		
	Average			15·5
(6)	Combined { Neglect and eso- or exophoria ...	5		
	Combined { Number of accidents	80		
	Average			16·0
(7)	Combined { Hyper- or hypophoria, eso- or exophoria and neglect	3		
	Combined { Number of accidents	58		
	Average			19·3

Turning now to the subject of visual judgment influencing the capacity for playing games, I will quote cases in which, after loss of the ability to land aeroplanes, the ability to play fast ball games was also lost, and both regained after a course of eye training.

It is suggested that the other Services may be interested in the subject of the relationship between industrial fatigue and defective oculo-muscle balance.

Space Perception.

I believe that a "space perception" is built up "after birth" from trial and error of those extrinsic muscular movements necessary for fixation. This process is in the first instance monocular, while at a later date binocular single vision develops in order to eliminate double images. Thus the infant subconsciously acquires co-ordination in ocular movements, and association tracts are formed to enable these movements to be carried out. This process is on a par with Sherrington's postural reflexes, and although in later life the primary ocular muscular elements are unconsciously controlled, yet any interference with their normal harmony will show itself by errors of judgment in regard to spatial relationships (a case of sixth-nerve paresis was quoted which illustrates this point). This, to my mind, may be regarded as an example of higher psychical activity initiated by stimuli arising from change of tone in the muscular system.

This question I wish to put to you is the following:—

Does the condition of heterophoria (1) serve to induce the symptoms of nervous instability through the unconscious nervous strain and fatigue brought about by the visual condition in the endeavour to maintain correct cerebral appreciation (keeping thus in line with the trend of modern opinion—namely, that the proper functioning of the higher centres is dependent on the integrity of the lower centres)? or (2) is the condition of ocular muscle imbalance additional and early evidence of a general condition of nervous instability on the part of the subject, following the law that in cases of retrogression, the most recently acquired and highly-organized co-ordinations are among the first to be deranged?

Such evidence as I can offer, had I the time at my disposal, would indicate that apparently there are cases belonging to each class.

Discussion.—Mr. A. HUGH THOMPSON said that it struck him as strange that in Commander Clements' tables the lateral errors of muscle balance appeared to be almost equal in importance to the vertical errors. In his experience, in civil practice, hypophoria was the only condition of this sort which commonly caused symptoms, and this was what was to be expected when we remembered that the reserve power of the lateral muscles and especially of the internal recti was many times more than that of the vertical muscles. The latter could only overcome a prism of two or three degrees, whereas the former could overcome quite high prisms placed base in and especially base out.

Wing-Commander CLEMENTS (in reply to Mr. Hugh Thompson's remarks) agreed that, except for the Bishop Harman test, the tests described were not in themselves actual tests of binocular vision, but that they were tests of a person's capacity to perform certain ocular movements on which he depended for the information necessary to form his judgment of distance. He (the speaker) further contended that he was justified in this assumption from the resultant improvement in judgment of distance shown by improved ability to land an aeroplane after eye training. He further agreed with Mr. Hugh Thompson that hyperphoria was more likely to interfere with the maintenance of binocular vision, although at first glance this was not so on examination of the tables quoted.

The following were possible explanations: (1) The smallness of the number of cases; (2) that, in the assessment of these cases, a lesser amount of hyperphoria was taken as a disability than in the case of eso- or exophoria.

In reply to the question put by another speaker, he stated that he was of the opinion that there were cases of both kinds caused by fatigue, illness or after-concussion: (1) Where aggravation of a pre-existing minor error of muscle balance occurred; (2) where there was a definite production of a defect in previously normal individuals, possibly at first only temporary but liable to become permanent if time were long enough to allow of a bad-habit formation in order to get rid of a temporary difficulty.

With regard to the question as to whether the neglect described could be explained by the selective power of the retina or colour rivalry, he (Wing-Commander Clements) explained that in all such cases, if carefully tested, evidence would be found of some other defect to account for this.

War Section.

President—Lieut.-General Sir WILLIAM B. LEISHMAN, K.C.B., K.C.M.G., F.R.S., A.M.S.

The Pathology of Mustard Gas Burns and its Relation to Problems of Prevention and Treatment.

By Major H. S. BLACKMORE, R.A.M.C.

I HAVE chosen the subject of my paper with the intention of putting before you some of the purely medical aspects of mustard gas in a concise and dogmatic way; the reason for both the conciseness and the dogmatism being the same, namely, the hope that discussion of debateable points may follow.

The name "Mustard Gas" is not a very fortunate one for two reasons: (1) It is apt to lead to confusion with the comparatively harmless "oil of mustard," an entirely different chemical body, and (2) it is not a gas at ordinary temperatures but a liquid, its freezing point being about 14° C., and its boiling point about 210° C.

ACTION.

The action of mustard gas is well known. It produces all stages of chemical burn from slight erythema to extensive vesication and tissue destruction. I would wish to lay stress upon the tissue destruction as being of considerable importance, and shall return to this point later when considering the question of healing.

Two of the salient features of mustard gas burns are: (*a*) The almost complete absence of sensation; (*b*) the delay in the appearance of clinical signs. Both these features are of great importance, whether the subject be viewed from the general staff point of view or from that of the medical services.

	Import to General Staff	Import to Medical Services
(*a*) Absence of subjective warning sensations such as burning, itching, pain, &c.	Casualties more likely to occur and more difficult to prevent.	Burns tend always to reach the maximum severity possible from any given degree of contamination.
(*b*) Delay in appearance of clinical signs.	Effect upon man-power is not immediate. Preventive measures can be employed, except as per (*a*) above.	Organization not called upon until after considerable time lag from zero of actual contamination by the gas.

N.B.—It is at present laid down that the Medical Services are not responsible for any measures of defence against gas, except for their own protection as units of the fighting forces.

Let us examine these two features a little more closely. It is not strictly accurate to say there are no subjective symptoms preceding the onset of clinical signs. In most cases there are certain mild sensations of vague discomfort, but in the vast majority the damage has then been done, and no preventive measures known to-day will then stop, or even mitigate, the development of the lesion. In some of the extremely sensitive individuals these subjective symptoms occur earlier, early enough for preventive measures to obtain some degree of success.

It may be that these subjective sensations are a factor in the rate of hydrolysis in this class of compound, although there is no relation, either direct or inverse, between it and vesicant power.

The delayed action of mustard gas is an apparent rather than a real delay. (Slide exhibited.) This slide shows a section of rabbit skin five minutes after the application of a drop of pure mustard gas to its shaven surface.

Although the action of mustard gas upon such a skin is more rapid than on the human skin—for reasons to which I shall refer later—I think you will agree its action *starts* almost immediately.

The next point I wish to make is that mustard gas causes extensive cell damage as well as capillary hæmorrhage and œdema of the skin.

Whether œdema of the skin or vesication results from the increased permeability of the vessel walls is purely an anatomico-mechanical question. In the animal skin the numerous hair-follicles, each with its lining of epidermis dipping down into it, "nail down" the epidermis as it were, with the result that the exudate, which naturally takes the line of least resistance, produces œdema instead of vesication.

At this point I would draw your attention to the fact, demonstrated for animal skin in this slide and for human skin in the next slide I am showing you, that mustard gas attacks the whole skin and not only the epidermal layers, whilst the blister formation, when it occurs, lifts up the whole epidermis. The delayed action therefore is apparent rather than real, and the damage done to the tissues is by no means fully represented by the vesication.

RELATIVE SOLUBILITY IN LIPOID (OLIVE OIL) AND WATER, AND RELATIVE VESICANT POWER.

Substance	Per cent. solubility (water)	Per cent. solubility (lipoid)	Vesicant power (*potential*)
"H" (Mustard) $S(CH_2CH_2Cl)_2$	1·88 } = 1·92 1·96 }	Miscible in all proportions	X
Sulphoxide of "H" $O=S(CH_2CH_2Cl)_2$	2·54 } = 2·48 2·41 }	1·79 } = 1·82 1·84 }	X +
Sulphone of "H" $O_2S(CH_2CH_2Cl)_2$	1·96 } = 2·07 2·19 }	6·15 } = 6·22 6·29 }	X + +

The next question I propose to discuss is that of relative solubility in water and in lipoids. Taking olive oil as a reasonably close approximation to the body lipoids as a class, the relative solubilities of mustard gas, the sulphoxide of mustard gas, and the sulphone of mustard gas are as follows: The figure given for the water solubility of mustard gas is a very rough approximation, as it is quite impossible to estimate it with any degree of accuracy owing to hydrolysis—this figure is certainly too high, probably considerably too high. You will note that their relative vesicant power is expressed in terms of mustard gas as 100, and you will see that sulphone of mustard gas is given a high figure. That is what may best be termed a figure of its *potential* vesicant power, because, owing to its relatively low lipoid solubility, it is only by employing special technique that this figure can be demonstrated. Its *actual* vesicant power under ordinary, say field service, conditions is infinitely less than that of mustard gas. A second point which emerges from a study of the relative action of mustard gas and its sulphone is this: the material having passed the protective layer of the epidermis is at once affected by this question of lipoid solubility, which determines the degree of spread—especially of lateral spread—which takes place. This, of course, in turn determines not only the degree of the resulting burn but its superficial area as well. This is well shown in the clinical observation of burns of approximately the same intensity produced by mustard gas and by its sulphone. The latter are much more discrete and heal much more quickly.

The last two points to which I draw attention are connected with the delay in healing—with the chronicity, of mustard gas burns, which is such an important factor in war. It can be demonstrated that after the application of mustard gas to the skin of a rabbit, that skin retains the power to produce clinically definite burns if transferred to other healthy rabbit skin. This power naturally diminishes progressively the longer the interval of time which is allowed to elapse before the transference is made, *but it can still be demonstrated clinically after an interval of as much as seventy-two hours.*

Secondly, a microscopical study of sections of mustard gas burns at various stages of repair brings to light the curious fact that the newly forming loops of capillaries, fibroblasts, and young regeneration cells generally, are "nipped off," like young plants by a frost.

Before closing my address I will mention one interesting fact, namely, that no action of mustard gas, or of its sulphone, can be demonstrated upon rabbit skin in the absence of *systemic* life. *Somatic* life (which I admit is only inferred) is not enough. The experiments on which I base this assertion are the following:—

(1) Mustard gas was applied to the skin of a living rabbit on two shaved areas well away from each other. It was left *in situ* for fifteen minutes. The animal was then killed and one area cut out and sections prepared. The second area was not removed until three hours later. No advance of the mustard gas effect can be demonstrated.

(2) A rabbit was killed by striking it at the base of the neck. A piece of skin, previously shaved, was cut out as quickly as possible and a drop of mustard gas applied to the outer surface. The whole was placed in a specially designed cell and a current of air drawn past the inner surface until mustard gas could be demonstrated in the air current (some 1½ hours later). Sections were then made; there was no evidence of any mustard gas effect at all.

Prevention and Treatment.

The foregoing is a rapid survey of the pathology on which we found our suggestions for prevention and treatment of mustard gas burns.

The fact that the delayed action is apparent and not real, plus the lipoid solubility, accounts for the fact that no method of prevention so far tried is capable of doing more than modifying the action, if exhibited later than fifteen minutes after the application of the mustard gas to the skin.

The high degree of lipoid solubility appears to be responsible for the fact that no successful method of "chasing" the mustard gas into the skin, and rendering it innocuous *in situ*, has yet been evolved.

Excision can be employed with success if the area is small enough.

The success of strong solutions of permanganate, 1 in 20 in water, as treatment would seem to be due to a combination of factors: (*a*) The oxidizing power; (*b*) the antiseptic power; (*c*) the "tanning" power.

Summary.

(1) The "delayed action" of mustard gas is apparent rather than real.

(2) Relative lipoid solubility has a great bearing upon the "*actual*," as opposed to the "*potential*," vesicant power of any given substance.

(3) The persistence of vesicant power in rabbit skin for a considerable period of time can be demonstrated.

(4) The effect of some body, or bodies, unknown upon the delicate cells of repairing tissue can be demonstrated.

(5) Mustard gas rapidly causes œdema formation, with considerable cell destruction as well as capillary hæmorrhage.

(6) "*Systemic*," as opposed to "*somatic*," life would appear to be necessary, if mustard gas is to demonstrate its burning power.

Discussion.—Surgeon-Commander G. R. McCowen said that the research the results of which were recorded in the excellent paper by Major Blackmore, was carried out at that very efficient centre, namely, the Physiological Department attached to the Chemical Warfare Station at Porton. He said that until recently he (the speaker) had been connected with this department at Porton for a number of years and could vouch for the authenticity of the excellent and original research carried out there. Major Blackmore had not told them of the difficulties which had to be overcome, of the continuous development of experimental technique and of the years devoted to thought and investigation before the conclusions expressed in his paper were arrived at. He (Commander McCowen) had followed this particular piece of research on the pathology of mustard gas for a number of years and concurred entirely with the author's conclusions. He would ask Major Blackmore the following questions: (1) Had the oxidation theory with regard to the mode of action of mustard gas and its analogues now been definitely accepted? (2) Would it not be better to state that the resultant effects of mustard gas on the skin could be modified, or possibly prevented, by prophylactic measures depending upon the rapidity with which such measures were carried out after contamination by mustard gas? Or were prophylactic measures only of avail in preventing or modifying the action of mustard gas on the skin if carried out within a certain time after contamination, say up to fifteen or twenty minutes? (3) Had the idea of the possibility of "chasing" the mustard gas into the skin now been abandoned? (4) Was potassium permanganate soluble at all in lipoids and did it penetrate the skin? If so, to what extent otherwise did it "chase" the mustard gas, or was its beneficial action purely superficial?

Colonel J. C. Kennedy said that Major Blackmore had ably stated the essential facts, so far as they were known, of the action of mustard gas and the treatment of its effects. He (Colonel Kennedy) was in the privileged position of being acquainted with all the recent work on this subject, and in spite of the vast amount of thought and research which had been devoted to the problem he was afraid that there had been no very material addition to our knowledge since the termination of the war. There was still some divergence of opinion as to whether a burn due to mustard gas should be placed in the same category as a burn due to heat or other chemical agents, but no one who had studied the histology of a mustard burn alongside that of a heat burn could help being struck by the difference. This difference lay in the persistence of a toxic agent in the tissues affected by mustard, the evidence of which could be demonstrated well into the third week. That explained why a mustard burn was slow to heal, quite apart from its liability to become septic. Experiments directed towards determining the nature of this toxic agent and neutralizing it, with a view to minimizing the degree of burn and promoting healing, had so far attained little success, but the permanganate treatment described by Major Blackmore was a distinct advance. The theory that the destructive effect of mustard was due to its conversion in the skin to sulphone was attractive, but the difficulties of proving or disproving it were very great. When Major Blackmore was describing the experiments with rabbit skin, which after an application of mustard was excised and applied to fresh skin, he (Colonel Kennedy) wondered whether Major Blackmore had observed the nature of the secondary burn. Did it come into the category of a mustard gas or a sulphone burn?

Squadron-Leader G. Struan Marshall drew attention to the statement of Flury and Wieland in 1921, that "mustard" did not vesicate as such, but only when oxidized into the sulphone. This seemed to be borne out to some extent by Major Blackmore's work, but to be contra-indicated by the relative lack of vesicant power of the sulphone, and he (the speaker) suggested that it was possible that the vesication was due, not to the extrinsic "mustard" or its sulphone, but to an intrinsic substance produced from the tissue cells. This possibility was increased by the persistence of "mustard" burns long after all traces of "mustard" must have been eradicated, and by the remarkable resemblances which existed between burns caused by "mustard" and those produced by a variety of forms of irradiation. He asked if Major Blackmore knew whether any comparative dermatological work had been done bearing on the relation between "mustard" burns and those caused by irradiation. He (the speaker) referred to cases within his experience where burns indistinguishable from "mustard" burns had been produced within fifteen minutes of exposure, notably in one case in which the subject was not hypersensitive and was burned on the wrist through incautiously scattering bleach on a quantity of spilled "mustard." Did Major Blackmore agree that this was probably the result of an initial burn by nascent

hydrochloric acid, the droplets carrying with them traces of "mustard"? He asked for an authoritative statement, for the guidance of those who were called upon to assess attributability of disease to service, as to the statement frequently made that "gassing" predisposed to tuberculosis.

Lieutenant-Colonel MARRIAN PERRY said that the sections exhibited by Major Blackmore were excellent; he had had the opportunity of examining them critically some months ago. He could fully confirm, if such confirmation was necessary—the accuracy of the observations made on the pathological changes which had been described. There was one minor point to which he directed attention. It had been shown that the irritant effect was manifested in a lateral direction outside the actual site of application of the mustard gas. The presence of gross histological changes was definite evidence of this occurrence, but alteration in the staining reaction of the more peripheral cells concerned in the lesion might possibly be due to chemical changes without any actual vital effect on the cells.

Sir WILLIAM LEISHMAN (President) said that to himself it was of deep interest to learn of the progress which had been made on the experimental side of this inquiry, with which, two or three years ago, he was more intimately connected than of late. There was no need to stress the immense importance of the objects of the inquiry—that would be clear to everyone; and although Major Blackmore had not been able to give a very hopeful account as to the practical application of the information yielded by the experiments to the control of burns caused by mustard, he himself was not without hope that further research on the chemical side might eventually put into our hands some effective method or agent. He had been especially interested in the work in connexion with the action of permanganate of potash; if this was likely to be of practical value he suggested that it would not be difficult to issue it to individuals in small ampoules, in the same way that iodine was issued early in the war when it was held to be of importance to apply it as early as possible to a wound. He would be glad if Major Blackmore had anything further of interest to communicate on two points: first, as regards evidence of either immunity or hypersensitivity following on repeated exposures to the effects of mustard gas; and, second, whether anything had come from the investigation of the American "poison-ivy," the effects of which presented a certain parallelism with those of mustard.

Major BLACKMORE (in reply) said that the "oxidation theory" of the mode of action of mustard was not by any means definitely accepted. All that could be said was that it had not been disproved, and that work on it was still proceeding. It was not accurate to say that prophylactic measures were of no avail, but that it was very necessary to keep clearly separated in one's mind the two questions: (*a*) Prophylaxis against burning after direct contact of liquid mustard with the skin, (*b*) burning produced by vapour emanating from contaminated clothing. In the first case, no measures yet devised were capable of stopping or modifying the burn unless applied within some fifteen to twenty minutes; in the second case, administrative arrangements for the early removal of contaminated clothing, washing of the patient, &c., had very marked effect in modifying, if not preventing, the subsequent burn. It should be clearly understood that a definite amount of mustard must be in contact with the skin for a definite time if a burn was to result. This equally applied whether the mustard was in a state of liquid or in that of vapour. Attempts to evolve a satisfactory "chaser" of mustard had been abandoned for the moment. Little hope was entertained of ever finding such a substance owing to the difficulties presented by the combination of the desiderata, some of which were mutually antagonistic, the desiderata being: (1) Lipoid solubility at least equal to that of mustard; (2) a small proportion of non-active substance which was only a "dead weight" in the molecule; (3) high degree of chemical activity; (4) stability; (5) selective action on mustard, or at least not a high degree of reactivity with the tissues; (6) no damaging effect on tissues *per se* and not producing so violent a reaction with mustard as to damage the tissues as much as, or more than, the mustard itself. Five per cent. permanganate would, *in vitro*, at 37° C., break up the mustard molecule, but its lipoid solubility was very low, and direct action on the mustard was only hypothecated to a small degree in assessing the reasons for its effectiveness in treatment. It was no use as a preventive, and experiments do not hold out any hope for its use in early treatment. Its place would seem to be after the development of the lesions. Comparison of the burn produced by the vesicant substance remaining in rabbit skin up to seventy-two hours after the initial application of mustard with that produced by mustard and that produced by sulphone had not yet been made. Sulphone, when applied to skin of rabbit immediately after death, produced no detectable damage, thus behaving just like mustard.